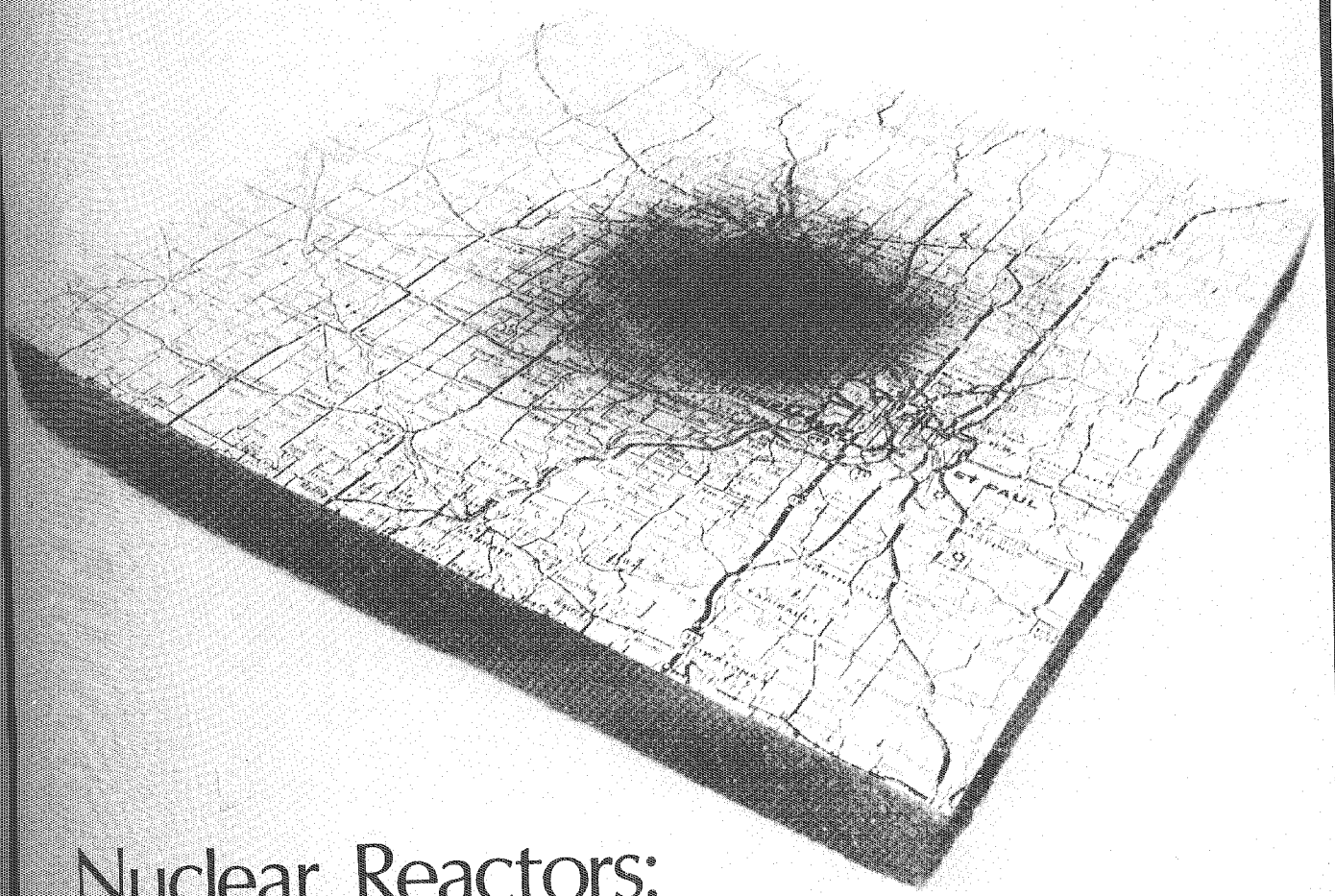
minnesota **Technolog** october 1974

COMMUNIST IN THE BACKYARD
LAUGHING GAS - THE PAWN
I.T. THINGS



Nuclear Reactors: How great the risk?

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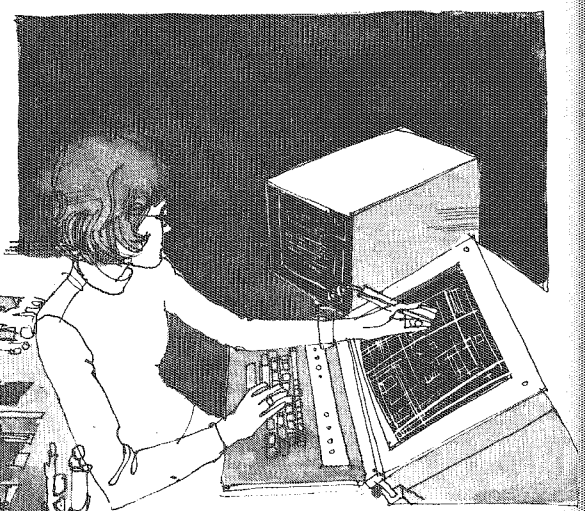
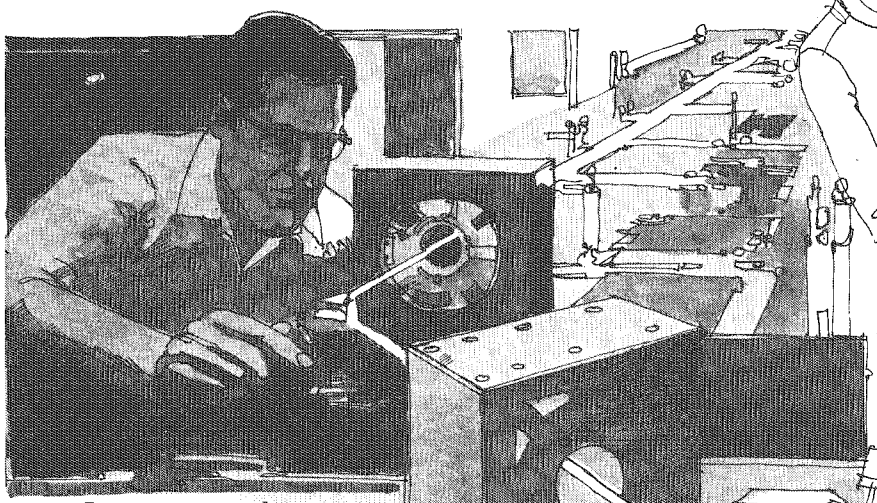
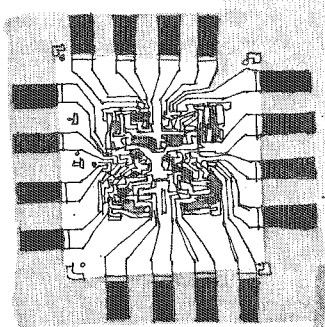


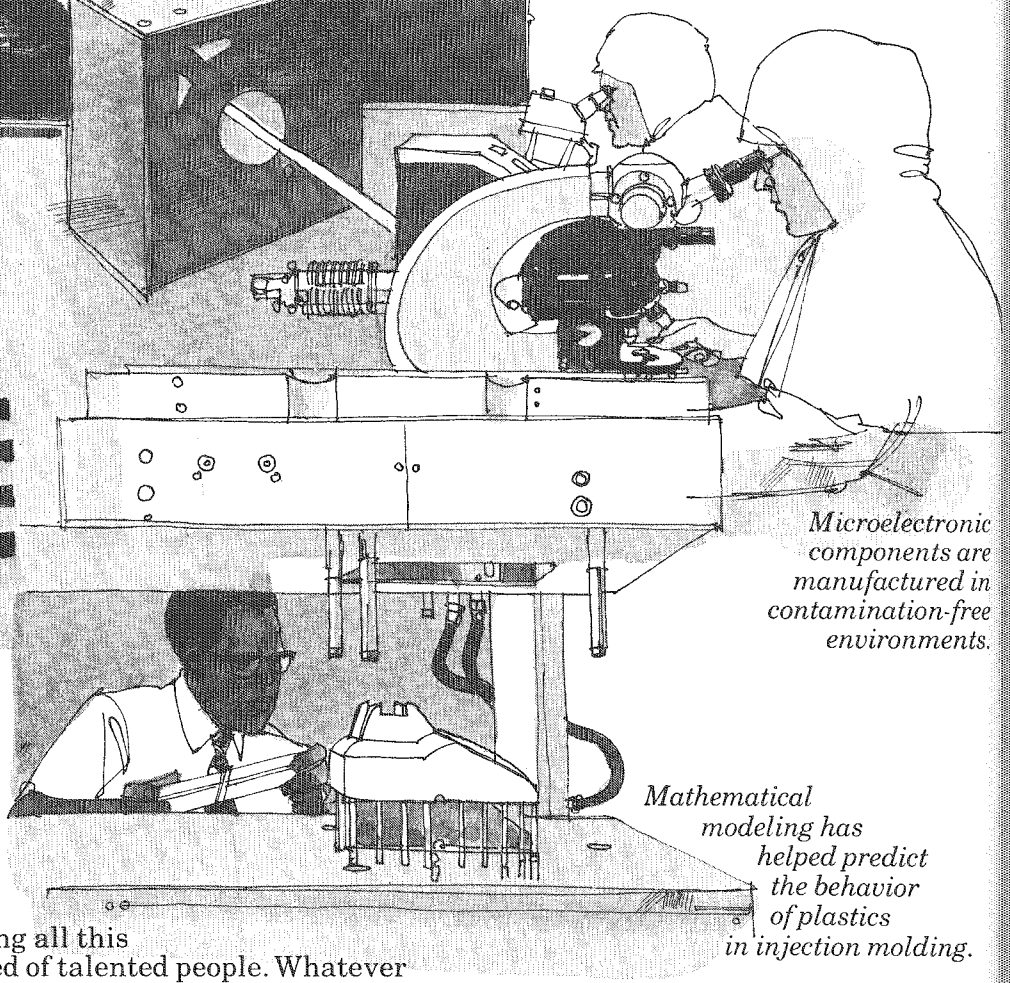
The installation diagrams for telephone switching centers have been generated through computer graphics.



Lasers are used in a variety of ways—from measuring to drilling and welding.



Like transistors before them, integrated circuits are spreading into every nook and cranny of the Bell System.



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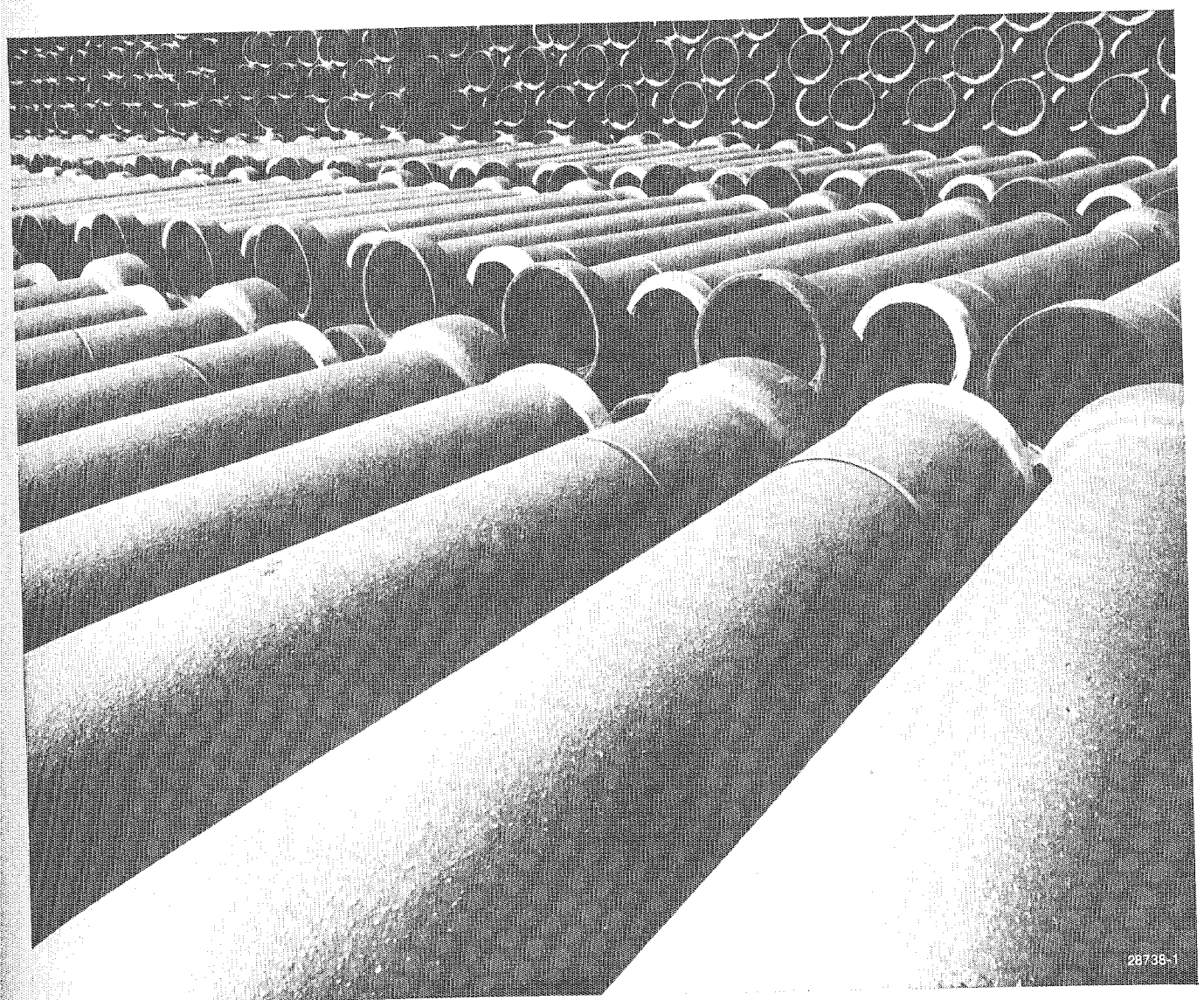

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Editorial Page

INTERIM PROGRAM:

A lot of the "glamour" engineering schools that are on the semester system have a four week interim period in the winter between semesters. During this time students are encouraged to delve deeper into a subject or explore new areas. To help with this, interested professors and students will sponser short mini-courses.

For example, at one school a professor ran a short course in the Dynamic Behavior of Squash Balls. The purpose was to experimentally determine the playing characteristics. It involved learning the various test methods required to determine the balls flight and bounce parameters. Another course explored the design and construction of foam homes like the one located in southern Minnesota.

At MIT, Professor J.W. Mar has been running a course called the Penultimate Sailplane. The goal is to design, fabricate, and flight test a sailplane using advanced composites as the primary stuctural material. The interim course served as an organizing medium for a small group of students who were interested in making a long term, three year, commitment to building the Penultimate Sailplane.

The course, Problems in Analog Circuitry gave participants a variety of theoretical and practical problems in analog circuit design and execution. These included A/D conversions, high and low-voltage power supplies, and novel applications of op amps.

The courses mentioned above are good examples of what can go on in an interim program. Interesting, almost frivolous topics such as Squash Balls can be studied while still picking up knowledge about experimental test procedures. Interested groups of students can be brought together to organize bigger projects as with the sailplanes. Also topics that are covered too briefly or not at all in regular courses can be made available.

Although the University is not on a semester system there is a large, four week gap between summer session and fall quarter. This would be an ideal time for I.T. to hold an interim program such as the one described above.

I know of many topics that could be ideal to have during such an interim program. Integrated circuit chip design and manufacture could be given during the interim. Present mini-courses in computer graphics and artificial intelligence could be given during the interim. In fact almost anything that several people were interested in learning about could be covered.

An interim program would provide many benifits. Many courses could be run so that it would allow someone without much knowledge in a certain subject to learn from the more advanced students. The program would help engineering students learn and do specific things rather than just the general topics covered in class. It would allow serious undergrads to learn about faculty projects in a way not possible through the regular course structure.

This seems like an ideal project for students to push for. Any costs could be paid for by a small registration fee so that students and faculty would have only to gain from a potentially good learning situation.

How about it?

Thomas Kraemer

You Don't Look Bluish...

Unexpected charges of discrimination have marred the otherwise smooth succession of C. Peter Magrath as president of the University.

It was revealed this month that the Board of Regents had once leaned toward another candidate for the job, David Saxon of UCLA. But at a secret Regents' meeting in April, Regents L.J. Lee and LoAnne Thrane objected to Saxon because of his religion—he is Jewish. Magrath was eventually offered the job.

Even more shocking, the other regents covered up the incident. Although faculty members were told almost immediately, the press was not informed until this month. Even then, the Regents refused to identify Thrane as the author of bigoted statements and allowed Lee to claim that he had merely objected to Saxon's lack of religous affiliation.

Those at the April meeting gained the impression that Lee and Thrane objected to Saxon specifically because of his Jewish background. Such an objection besides violating federal and state civil rights laws, threatens every area of the University, including IT. The time is not far behind us when the IT placement office carefully reported the religion and race of its graduates to employers, who then denied interviews as they chose. In every area of the community and in industry, the University is expected to lead the move toward insuring equal opportunity for everyone. But it has abandoned that responsibility in choosing its president. Regents Lee and Thrane have hurt the University and all of its students.

The damage can never be undone. But, at the least the Regents should never again be allowed to hold a closed meeting. In addition, a public inquiry should determine exactly what was said during the process of selecting Magrath as president. If the ugly rumors are proved true, Lee and Thrane should be forced to resign. The Regents owe that much to the University.

Larry Yarc

Reader response and participation in the Technolog **encouraged. Letters, comments, artwork, articles or article suggestions should be brought to the attention of the editor, Thomas F. Kraemer, room 2 Mechanical Engineering Building.**

Yes Virginia, There is an I.T. Dean

Dean Swalin doing his Gerald Ford imitation.

Last year the **Technolog** became suspicious that the Institute of Technology was being run by an IBM 360 computer named Marvin Snobol. We are glad to report that this is not true. There is indeed a dean of I.T., as you can see in this candid Polaroid picture that one of our ace reporters was able to snap before the Dean was able to slip beneath his desk.

An Emphasis on Teaching Ability: In an interview with Dean Richard Swalin several interesting points were brought out. Despite rumors that teaching ability is ignored in I.T., it is a prime requisite for hiring and promotion. Swalin mentioned, "If the students don't like a professors teaching ability, and the professor doesn't want to share his knowledge through teaching, we suggest to them that they work at an industrial lab." Similarily I.T. has no "research professors". All faculty must share in the teaching.

Of course I.T. only has the ability to fire untenured assistant professors who typically have been here less than seven years. Dean Swalin mentioned the problem of giving tenure to someone on the basis of only seven years of work.

Some Raw Data: According to Dean Swalin there are about 375 faculty members, and 1500 graduate students in I.T. The Institute grants an average of 4 undergraduate degrees per faculty member in comparison to 1.9-2.2 at some of the "glamour" schools. I.T.'s Phd output is only .3-.4 Phd's per faculty in comparision to .7-1 at other schools.

This year's freshman enrollment is expected to to be up 25-30%. On the basis of returns from 74 engineering schools, engineering enrollment should be down on a nation wide basis. EJC's Engineering Manpower Comission report stated that most of the decreases are reported by small schools, which make up half of the 74 school sample. The 35 large schools in the sample showed a slight increase. Sophmores had the least decrease being down only 3.3%. However this years juniors are down 12%. Seniors are down 4.4% and Freshman down 3.8%.

The Retention Program: The low attrition rate reflected in the sophmore figures could mean that engineering schools have been unusually successful in retaining last year's freshmen. I.T., in fact, has a program to help retain students. Dean Swalin told us about a study made a number of years ago that found almost half of I.T. students were transferring or flunking out even though they were just as intelligent as the students who remained. Presently only 21% of the students flunk or transfer out of I.T., which Dean Swalin feels is just about right. But it must be added that many students transfer in from other colleges after their freshman year.

The retention programs' funds pay for various I.T. tutors and counselors. For people living in the dorms, there are live-in tutors, and whole floors,with I.T. resident advisor, set aside for I.T. students. For commuters, tutors are available at a number of high schools around the Twin Cities.

Striving for Excellence: Dean Swalin summed up the philosophy of I.T. with the word "excellence". (engineers are known for being brief) Excellence in faculty and curriculum.

I.T.'s purpose is to teach engineering fundamentals, or in the case of the sciences, the fundamentals of science. It is not,as Swalin said, "To build a small pilot plant in the Chemical Engineering Building."

Swalin felt that excellence in curriculum is being achieved by making the engineering program less rigid through the coherent elective or track programs in each major. Excellence in faculty is cultured by taking appointments and promotions seriously and on a merit basis. Overall, Swalin feels that U of MN I.T. offers both the undergrad and the grad much opportunity for an excellent education.

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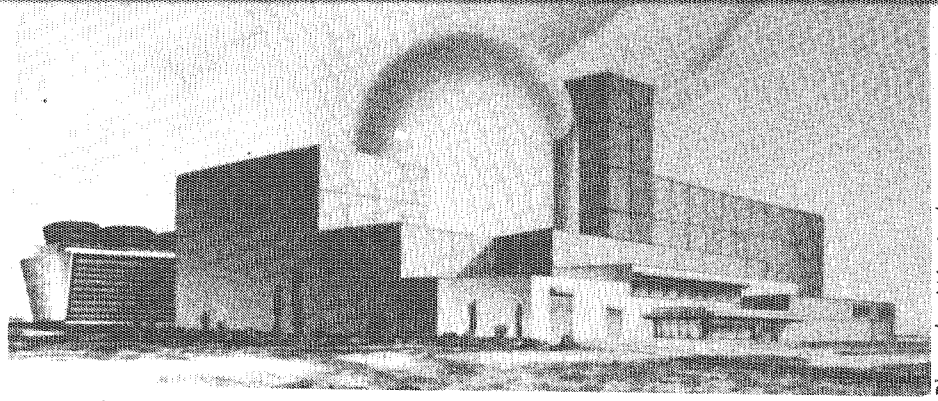


Photo by Westinghouse.

Nuclear Accidents

How Great the Risk?

Larry Yarosh

The first major study of nuclear accidents in 17 years was released this summer by the Atomic Energy Commission. The study, headed by Norman C. Rasmussen of MIT, is the result of two years of work by a staff of 60 people and the expenditure of three million dollars. It attempts to assure the public that nuclear power plants can operate without posing a threat to lives and property.

The study concludes that serious reactor accidents will occur with a probability of 1 in 17,000 per reactor per year. In the year 1980, when 100 reactors are expected to be in service, accidents will occur with a frequency of one every 175 years.

Ninety per cent of the accidents will have health effects too small to measure directly and will cause about $100,000 damage to the surrounding area. The worst accident recognized by the study could occur once in 200 million years per reactor and kill 2300 people outright, causing $6 billion in property damage.

All possible accidents taken together present the individual with one chance in 300 million of dying in a nuclear accident in any one year. This is less risk than that posed by many other calamities that society takes for granted(Fig. 1).

The problem of decay-generated heat: Two events were rejected by the study as being utterly improbable. First, the fission chain reaction cannot accelerate to the point of causing an atom bomb—like explosion. The reactor fuel contains only 3-5% U_{235}, the fissionable uranium isotope. Nuclear weapons need almost pure U_{235} to sustain an explosion.

The second possibility is for the reactor to operate out of control and produce an unmanageable amount of heat. The reactor is designed to be naturally self-limiting, and any loss of cooling water, which also acts as a moderator, would immediately cause heat production to drop to about 7% of the operating level.

The chief problem of reactor safety centers around this remaining 7%—heat produced by the natural decay of radioactive atoms after the chain reaction has ceased. Fresh Uranium dioxide, the nuclear fuel, is not highly radioactive but as the Uranium atoms fission, they produce a series of highly radioactive daughter atoms. If the heat generated by their radioactivity is not carried away, the fuel will overheat.

If the fuel reaches 5000° F it melts, falling through the bottom of the reactor vessel and, eventually, through the concrete foundation of the plant. Pressure generated by the heat and possible chemical reactions may rupture the containment building, allowing radioactive gases and dust to escape into the environment. This released radioactivity, containing radioactive iodine, krypton and strontium, is the chief threat to human beings.

In order to prevent such a disaster, nuclear power plants are required to have a series of safety features. These include:

1. *Containment Integrity.* The reactor vessel and its cooling system are housed in an air-tight containment building, trapping any radioactivity that may escape from the equipment.
2. *Reactor Trip.* Automatically stops the chain reaction at the first sign of trouble by inserting neutron absorbers into the reactor core.
3. *Emergency Core Cooling System.* Floods the reactor core with water to prevent overheating in case the main cooling system fails. Water contains boron to prevent the chain reaction from re-

Probability Table of Man-Caused and Natural Events: Fig. 1

Type of Events	Probability of 100 or more Fatalities	Probability of 1000 or more Fatalities
Airplane Crash	1 in 2 years	1 in 2000 years
Fire	1 in 7 years	1 in 200 years
Explosion	1 in 16 years	1 in 120 years
Toxic Gas	1 in 100 years	1 in 1000 years
Tornado	1 in 5 years	very small
Hurricanes	1 in 5 years	1 in 25 years
Earthquake	1 in 20 years	1 in 50 years
Meteorite Impact	1 in 100,000 years	1 in 1,000,000 years
Reactors		
100 plants	1 in 10,000 years	1 in 1,000,000 years

suming.

4.*Post Accident Radioactivity Removal.* Sprays and filters to collect radioactivity from the atmosphere inside the containment building, lessening the amount of radioactivity that might be discharged into the enviroment.

5.*Post Accident Heat Removal.* Cooling water to remove heat from the containment, preventing build-up of pressure that might rupture the containment building.

6.*Deisel generators.* Ironically, a plant might find itself in an emergency without the electricity to operate the safety devices mentioned above. A set of deisel generators provides standby power in case the external power fails.

Event Tree analysis: If these systems work properly, even a major pipe break can be handled without any fuel melting or release of radioactivity. The consequences of an isolated equipment failure depends on the exact situation. The complex relationships between the different devices are analyzed by the methods of systems analysis, including the *Event Tree.*

A typical *Event Tree* is shown in Fig. 2. Column A represents the initiating event—a major pipe break. The event is characterized by a probability of occurrence, P_A. Column B represents the electric power supply. The upper branch of the tree represents a properly functioning electrical system, while the lower branch represents electrical failure, with the probability, P_B. The process continues through column E, which has a branch for every possible state of the five devices. The probability of occurrence for each state of the system is found by multiplying the probabilities of the elements that go to make it up.

These elements are interdependent—the event tree may be modified. In this example, the devices in columns C,D,E all require electric power. If the power fails, they must all fail and there can be no other outcome. The lower event tree reflects this fact.

If the event tree has been constructed with care, the series of events in each branch are well defined so that it is possible to calculate the consequences for that outcome. For example, the bottom branch in Fig. 2 where emergency core cooling fails, can be shown to result in melting of the reactor core. The fraction of core radioactivity released can then be calculated.

Through the use of event trees and a similar method, the fault tree, complex problems can be analyzed in terms of simpler problems. Events in which we have no experience, such as a major reactor breakdown, can be predicted from the experience that we do have with the individual pumps, valves and switches.

A possible accident: How might a serious nuclear accident come about? From among the many possibilities considered in the study, the following scenario describes an accident that might occur with a Boiling Water Reactor, like the type operated by Northern States Power Co. at Monticello, Minnesota.

In this accident, a large pipe break is followed by failure of the Emergency Core Cooling System. As the cooling water boils away, the chain reaction dies out, leaving only the heat produced by radioactivity of the fission products.

The temperature of the reactor

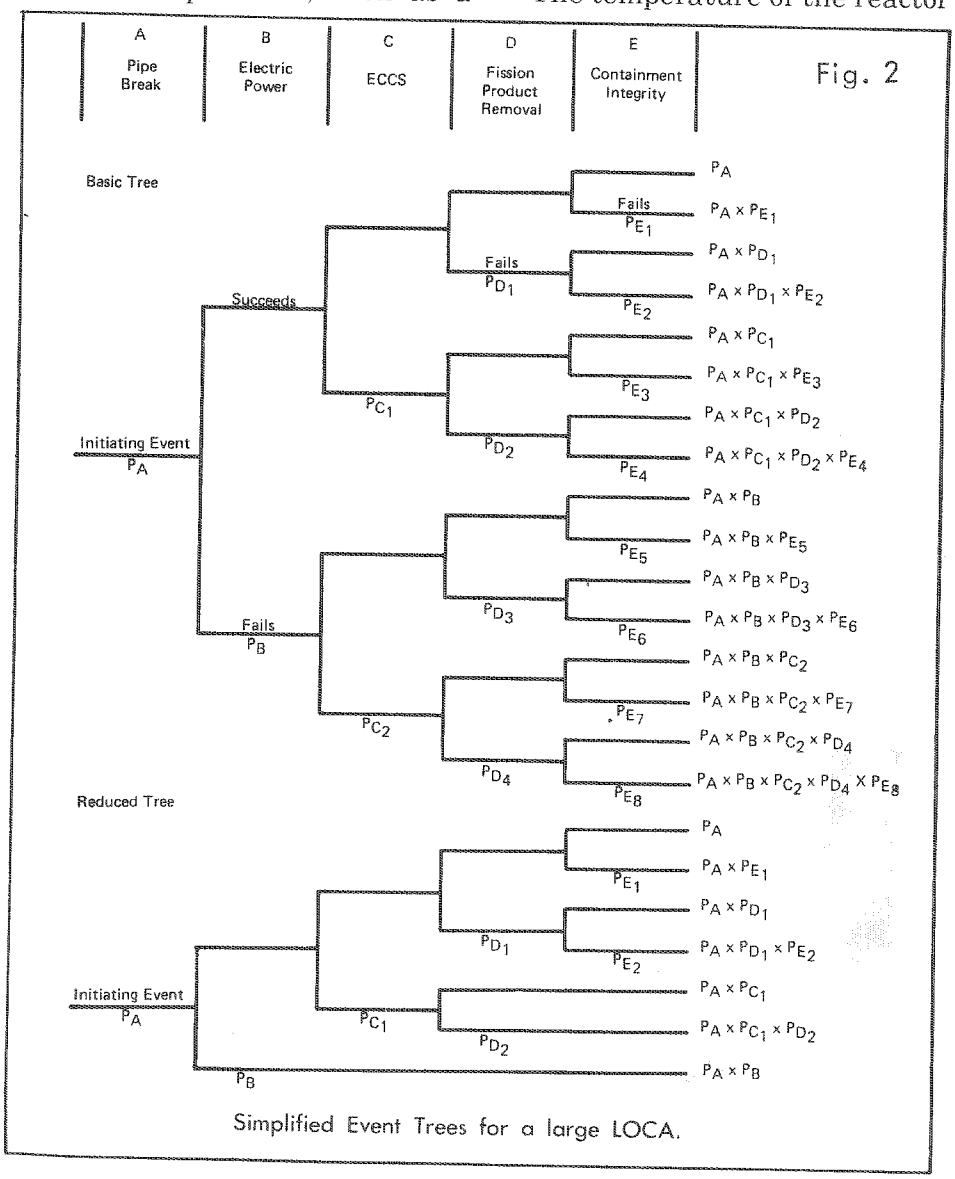


Fig. 2

Simplified Event Trees for a large LOCA.

and falls to the floor of the containment building. About two hours after melting begins, the molten fuel reaches the water sump, producing a steam explosion. The explosion is of sufficient force to rupture the containment building, allowing radioactive gases and dust to escape into the enviroment. The molten fuel eventually eats through the concrete foundation of the plant and solidifies in the earth below.

As soon as the core begins to melt, all persons living within five miles of the plant are evacuated. Drugs may be administered to prevent the absorption of radioactive strontium and iodine.

In areas receiving high radiation doses, land may be quarantined for a time or subjected to clean up measures. Milk and farm produce in the area are inspected, and excessively radioactive shipments are seized. Almost all land is eventually returned to productive use.

The escaped radiation can be expected to produce 48 deaths total cost of evacuation, seizure of contaminated farm produce and property destroyed (exclusive of the plant itself) may come to $1.2 billion.

The probability of this accident occuring is 2 x 10-6 per plant per year, or once in 500,000 years,

Are the predictions accurate? The report's conclusions sound reassuring—even a major reactor accident is less destructive than many other disasters, and the overall risk to the public is less than that from many activities taken for granted. But are the conclusions accurate? No one has ever let a reacter overheat to test its safety systems. The intensive testing needed to perfect almost every other engineering device can not be done for a complete nuclear power plant. The report's predictions are based on a lengthy and complex analysis that will never be tested until a disaster occurs.

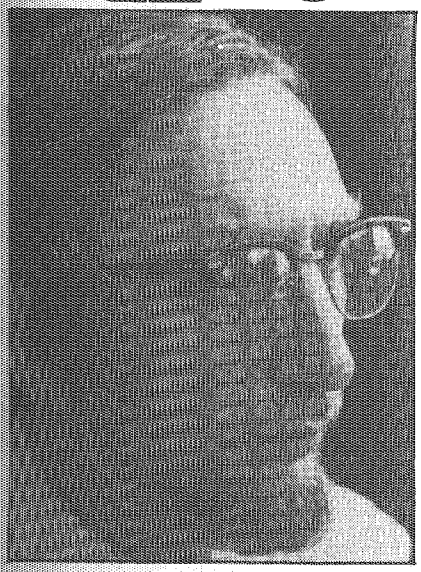
The analytic methods themselves are relatively new. The fault tree method was first used in 1961 by Bell Laboratories in

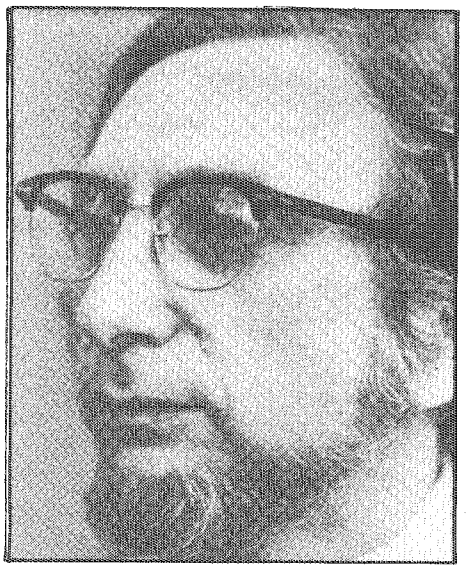
authors have gone to great length to correct the estimates by identifying dependencies between separate failures, and checking the results with other analytic techniques. In the few cases where the results could be checked against experience, they are satisfied with the correlation.

The report remains far from conclusive, and the critics of nuclear reactors are analyzing it carefully, looking for weak points and contradictions. Critics have already pointed out that the report makes no allowances for sabotage (which is being considered in a separate report, still being prepared). Further, it analyzes reactor development only through 1980, when about 100 reactors will be in operation and makes no provisions for the Liquid Metal Fast Breeder Reactor (LMFBR) still being developed.

The issue of nuclear development is still undecided, but it could be the most important environmental decision yet made.

A COMMUNIST in the Back Yard





By Larry Yarosh

A Physics professor and past treasurer of the U of MN Federation of Teachers has become the first Communist candidate in 32 years to run for governor of Minnesota.

Erwin Marquit, who left the US in disillusionment twenty five years ago, was chosen July 2 as the gubernatorial candidate of the Communist Party of Minnesota. Asked about his proposals for government, Marquit outlined a broad series of both state and federal actions that would place our natural resources under public ownership. They include:

Food distribution. Monopolies in food production and distribution would be replaced with operations run by both state and local governments and cooperatives. Companies such as Red Owl Stores, which Marquit termed "parasitic" would be taken over. Would the stockholders be compensated? "The extent to which they are compensated would depend on the character and history of the company." Marquit answered. The resulting government operations would not only eliminate the payment of profits, but could serve as a check on inflation by controlling food prices.

Electric Utilities. Government-owned electric companies, Marquit argues, consistently charge lower rates than private utilities. "Minnesota has 200 public utilities," he says "and their rates are lower than the average rates of the private utilities." Memphis, Tennessee, which uses government-generated electricity, pays 1/3 less than nearby areas pay for privately generated energy.

Making a quick slide-rule calculation, he claims that residential users consume 30% of the electrical energy in the US, but pay 40% of the bills. "Private utilities can't be trusted." he concludes.

Iron mining. Since the closing of the US Steel plant in Duluth, Minnesota's role in the steel industry has been confined to producing ore, which is refined elsewhere. "Minnesota is being treated as a colony," Marquit said. "Minnesota produces 2/3 of the country's taconite, but no steel." By constructing its own steel mills, the state could produce 10 million tons of steel per year, creating 75,000 jobs, he argues. "With steel selling at about $200 per ton, that would make us the richest state in the US. It would revive Duluth as a major industrial port—with two-way traffic."

Technological Stagnation

A traditional strength of capitalism has been its ability to raise large sums of money for industrial development. Yet Marquit charges that US industry is falling behind the world in technical progress. "The country as a whole is in a very bad technological crisis," he claims. Oil production this year is below that of last year. For the 52 weeks ended August 17, the production of electricity is exactly the same as the year before. Industries such as steel and railroads are in a serious crisis. "Steel mills are working at full capacity," he says, "but production is lower this year than last."

Marquit suggests that all these industries suffer from a lack of capital investment—in a year when the US has invested $23 billion overseas. "Capitalism cannot deal with new technology." he says. The largest blast furnace in the world is now in the Soviet Union, 1/3 larger than our

largest. Their largest electric transmission line, at 1.5 million volts, is twice as large as the largest in the US. "The goal of our thermonuclear research program," he claims, " has been not to fall more than two years behind the Soviets. The profit motive does not encourage investment."

Education: all can learn

As a teacher, Marquit believes that everyone can benefit from higher education. Noting that the socialist countries have set a goal of universal higher education, Marquit argues that college should be free and that students should receive stipends while they are going to school. "As a graduate student in Poland, I was given a salary 50% above the national average." he says, adding that he was expected to serve as a teaching assistant.

As a faculty member, he is in favor of expanding the slower freshman physics section that spreads the usual first two quarters of study over three. "Our primary function should be to educate, not to weed out." he says.

A former DFL'er. Marquit first joined the Communist party in 1946. An electrical engineer, his last specialty was church illumination before he left the US. After visiting several European countries, he eventually enrolled at the University of Warsaw in Poland. "In those days," he says, "you couldn't write a Physics thesis in the US without a security clearance." He received his PhD at Warsaw in 1963 and returned to the US. He joined the University's Physics department in 1966 as a specialist in high energy physics.

In Minnesota, he became active in the DFL, serving as an alternate to the 1970 state convention in Duluth and supporting George McGovern's presidential campaign. In September of 1973 he rejoined the Communist Party, eventually becoming the acting chairman of the Minnesota branch.

What does Marquit think of Watergate? "I was asked about Watergate when I was in Eastern Europe this summer," he said "and I told them that Nixon did to the Democrats what the Democrats and Republicans have been doing to the Communists for 50 years."

Student Communists at the University are overshadowed by the Young Socialists and the Young Socialist Alliance—two groups that often quarrel with each other as often as with the major parties. Does Marquit support them? "They are for socialism in name only." he answered. "They oppose socialism wherever it appears."

Marquit will teach an honors seminar winter quarter entitled "Marxist Philosophy of Science in Society" based on his readings of Marx, Engels and Lenin.

In the meantime, he remains a Communist candidate. "Communism," he avows, "is the most powerful movement in the world."

INSTRUCTIONS: Unstaple, unfold, and remove the fantastic 1974-1975 Technolog Calender. A limited number of unstapled, unmutilated, printer's overrun copies will be available Oct. 6, between 1:30 and 4:30 P.M. in Room 2 MechE.

Unfold & Unstaple me!

SF CONTEST

TECHNOLOG'S ANNUAL SF WRITING CONTEST: TECHNOLOG is holding the SF writing contest again this year. The SF can stand for Science Fiction, Science Fantasy, Speculative Fiction, or Space Fantasy.

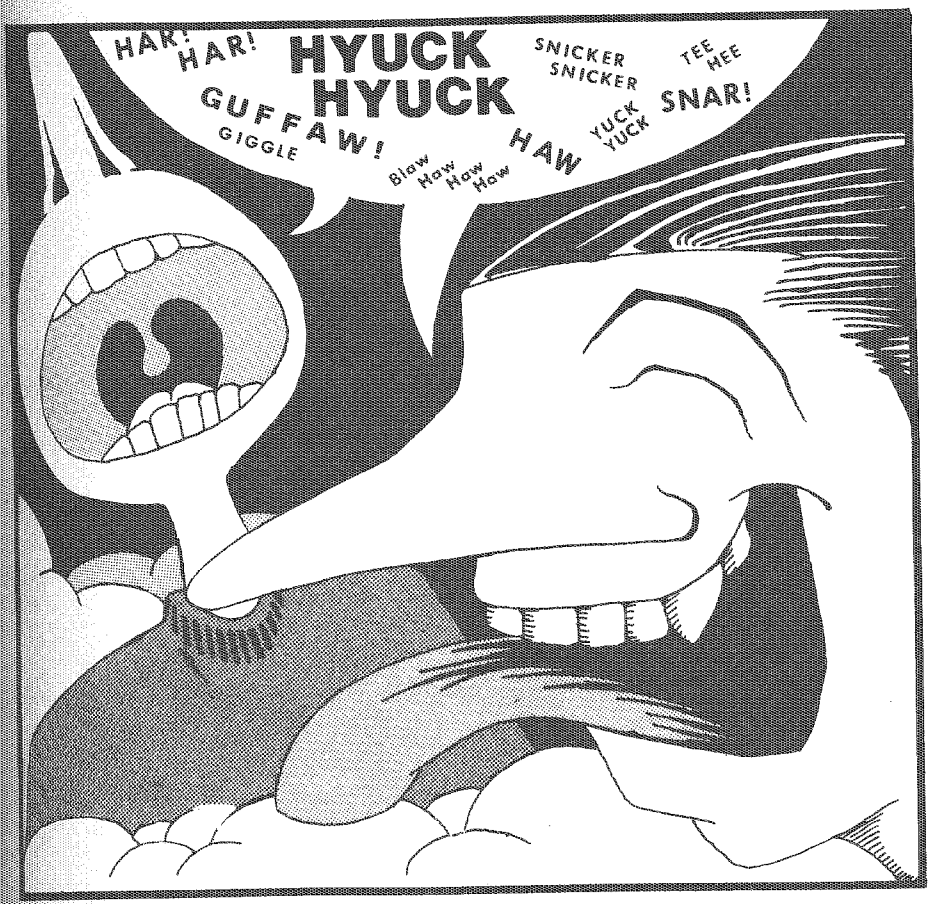
There will be no subject limitations. Stories will be judged on originality and style.

The winning entry will be published in the first Winter issue of TECHNOLOG. The author will recieve a $50.00 prize. Second and third prizes will also be awarded.

Entries must be typed, double-spaced, and not to exceed 2000 words (about 10 pages). The author's name shall appear only on a front cover sheet that may be numbered and removed for fair judging.

The deadline will be Thursday, December 5, 1974 — study day. Manuscripts should be turned into Room 2 MechE.

Further information is available in Room 2 MechE.



LAUGHING GAS

The first place that I remember seeing laughing gas was in a Bowery Boys movie. I dismissed it from my mind as an old fashion novelty until just recently when a dentist asked me if I would take nitrous oxide as a pain killer. The experience fascinated me. The following article gives some interesting facts about nitrous oxide (laughing gas) as well as excerpts from one of the original scientific accounts of nitrous oxide.

If you are the type that likes to do chemical investigations into your mind, then laughing gas is for you. Laughing gas is used by dentists and it is used in whip cream dispensers.

Laughing gas was discovered in 1772 by Joseph Priestly, a dissenting minister in Bristol, England. He prepared the gas that he called "Dephlogisticated Nitrous Air" while trying to determine if dry carbon dioxide would dissolve iron. He ran several experiments with the gas, which was later named nitrous oxide, but he never inhaled it.

Nitrous oxide is a powerful analgesic(pain killer)and a weak anesthesic, which makes it ideal for dental work. It is usually administered with 20%-35% oxygen and it can be inhaled for extended periods of time provided that enough oxygen is present. Pure nitrous oxide is often administered for brief dental operations.

Laughing gas takes effect almost immediately, and fades out of the system in less than half an hour. A mental "high" lasts for about one or two minutes.

Nitrous oxide itself is a harmless innocuous substance. The princple danger in using it is oxygen deprivation.

Even so, contrary to popular myth, the death rate throughout twenty decades of medical N_2O use is infinitesimal.

There is some evidence that a tolerance to N_2O develops after repeated or prolonged administration. Clinical observation has shown that after 12 to 24 hours of N_2O exposure rats become more easily aroused and consume more water and food. After long sessions of N_2O use, human users require 35% more gas to reach a "high".

According to a local Minneapolis gas supplier you can buy a four foot cylinder of N_2O for about $40 in small quantities.(you must have an approved cylinder) The one catch is that most suppliers require certification that you are either a dentist or a restaurant, with a good enough credit rating to be billed. Additionally four foot tanks are expensive to purchase or rent.

One of the first recorded "scientific" accounts of laughing gas ingestion was April 11, 1799 when Humphry Davy tried some. He proceeded to experiment ingesting between six and nine quart at a time. He gave the gas to friends; he gave it to animals; he sat inside a nitrous oxide filled box for ninety minutes. Other people noted that Davy often was seen dashing about his laboratory and falling on the floor.

Portions of his book on the subject are reprinted here. It is very interesting to read how a scientist 200 years ago went about exploring the "new" subject of laughing gas.

Division I:

A short time after I began study of Chemistry, in March, 1798, my attention was directed to the dephlogisticated nitrous gas of Priestley, by Dr. Mitchill's Theory of Contagion. Dr. Mitchill attempted to prove from some phenomenon connected with con-

tagious diseases, that dephlogisticated nitrous gas which he called oxide of septon, was the principle of contagion, and capable of producing the most terrible effects when respired by animals in the minutest quantities, or even when applied to the skin of muscular fibre.

The fallacy of this theory was soon demonstrated, by a few coarse experiments made on small quantities of the gas procured from zinc and diluted nitrous acid. Wounds were exposed to its action, the bodies of animals were immersed in it with out injury; and I breathed it mingled in small quantities with common air, without remarkable effects. An inability to procure it in sufficient quantities, prevented me at this time from pursuing the experiments to any greater extent. I communicated an account of them to Dr. Beddoes.

In 1799, my situation in the Medical Pneumatic Institution, made it my duty to investigate the physiological effects of the aeriform fluids, the properties of which presented a chance of useful energy. At this period I recommenced the investigation.

A considerable time elasped before I was able to procure the gas in a state of purity, and my first experiments were made on the mixtures of nitrous oxide, nitrogen and nitrous gas, which are produced during metallic solutions.

In the beginning of March, I prepared a large quantity of impure nitrous oxide from the nitrous solution of zinc. Of this I often breathed the quantities of a quart and two quarts generally mingled with more than equal parts of oxygen or common air. In the most decisive of those trials, its effects appeared to be depressing, and I imagined that it produced tendency to fainting: the pulse was certainly slower under its operation.

I was aware of the danger of this experiment. It certainly would never have been made if the hypothesis of Dr. Mitchill had in the least influenced my mind. I thought that the effects might possibly be depressing and painful, but there were many reasons which induced me to believe that a single inspiration of a gas apparently possessing no immediate action on the irritable fibre, could neither destroy nor immediately injure the powers of life.

On April 11, I made the first inspiration of pure nitrous oxide; it passed into the bronchia without stimulating the glottis, and produced no uneasy feeling in the lungs.

The results of this experiment proved that the gas was respirable, and induced me to believe that a farther trial of its effects might be made without danger.

I did not attempt to experiment upon animals, because they die nearly in equal times in non-respirable gases, and gases in-

Joseph Priestley (1733-1804). Priestley discovered laughing gas in 1772. His revolutionary views led a mob to burn down his house. After the French Revolution had overthrown the aristocracy, he was offered asylum in France. He then fled to England and post-revolutionary America.

capable of supporting life an possessed of no action on the ver ous blood.

At the end of July, I left off m habitual course of respiratio but I continued occasionally breathe the gas, either for th sake of enjoyment, or with a vie of ascertaining its operatio under particular circumstances

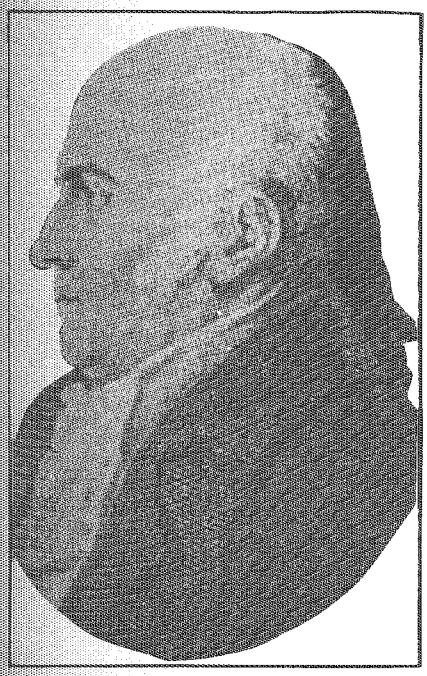
The power of the immediate o eration of of the gas in removin intense physical pain, I had very good opportunity for asce taining.

In cutting one of the unluck teeth called dentes sapientiae, experienced an extensive i flammation of the gum, accon panied with great pain, whic equally destroyed the power repose, and of consistent action

On the day when the inflam mation was the most trouble some, I breathed three doses nitrous oxide. The pain alwa diminished after the first four five inspirations; the thrillin came on as usual, and uneasine was for a few minutes swallowe up in pleasure. As the form state of mind however returne the state of organ returned wit it; and I once imagined that th pain was more severe after th experiment than before.

In a conversation with M Watt, relating the powers gases, that excellent philosoph told me he had for some time e tertained a suspicion, that the fects attributed to oxygen pr duced from manganese by hea in some measure depended up the nitrous acid suspended in th gas, formed during ignition the union of some of the oxygen the manganese with nitroge likewise condensed in it.

In the course of experiments nitrous acid, detailed in Researc I, made in September, Octob and December 1799, I sever times experienced a severe o pression on the chest and dif culty of respiration, not u analogous to that produced by o ygen, but much more violen from breathing an atmoshpe loaded with nitrous acid vapou



Thomas Beddoes. In 1799, Beddoes opened the Pneumatic Institution in Bristol, England to study theraputic uses of gases. It was Beddoes who hired Sir Humphry Davy as his assistant and gave him the equipment and encouragement to pursue his experiments with nitrous oxide.

This fact seemed to confirm Mr. Watt's suspicion.

To ascertain with certainty, whether the most extensive action of nitrous oxide compatible with life, was capable of producing debility, I resolved to breathe the gas for such a time and in such quantities, as to produce excitment equal in duration and superior in intensity to that occasioned by high intoxication from opium or alcohol.

To habituate myself to the excitement, and to carry it on gradually, on December 26, I was inclosed in an air-tight breathing box, of the capacity of about 9 cubic feet and half, in the presence of Dr. Kinglake. . .

I now came out of the box, having been in precisely an hour and quarter.

The moment after, I began to respire 20 quarts of unmingled nitrous oxide. A thrilling, extending from the chest to extremities, was almost immediately produced. I felt a sense of tangible extension highly pleasurable in every limb; my visible impressions were dazzling, and apparently magnified, I heard distinctly every sound in the room, and was perfectly aware of my situation. By degrees, as the pleasurable sensations increased, I lost all connection with external things; trains of vivide visible images rapidly passed through my mind, and were connected with words in such a manner, as to produce perceptions perfectly novel. I existed in a world of newly connected and newly modified ideas I theorised—I imagined that I made discoveries. When I was awakened from this semi-delirious trance by D. Kinglake, who took the bag from my mouth, indignation and pride were the first feelings produced by the sight of persons about me. My emotions were enthusiastic and sublime; and for a minute I walked around the room, perfectly regardless of what was said to me. As I recovered my former state of mind, I felt an inclanation to communicate the discoveries I had made during the experiment. I endeavoured to recall the ideas, they were feeble and indistinct; one collection of terms, however, presented itself: and with the most intense belief and prophetic manner, I exclaimed to Dr. Kinglake, *"Nothing exists but thoughts!– the universe is composed of impressions, ideas, pleasures and pains!"*

About three minutes and half only had elasped during this experiment, though the time as measured by the relative vividness of the recollected ideas, appeared to me much longer.

From the nature of the language of feeling, the preceeding detail contains many imperfections; I have endeavoured to give as accurate an account as possible of the strange effects of nitrous oxide, by making use of terms standing for the most similar common feelings.

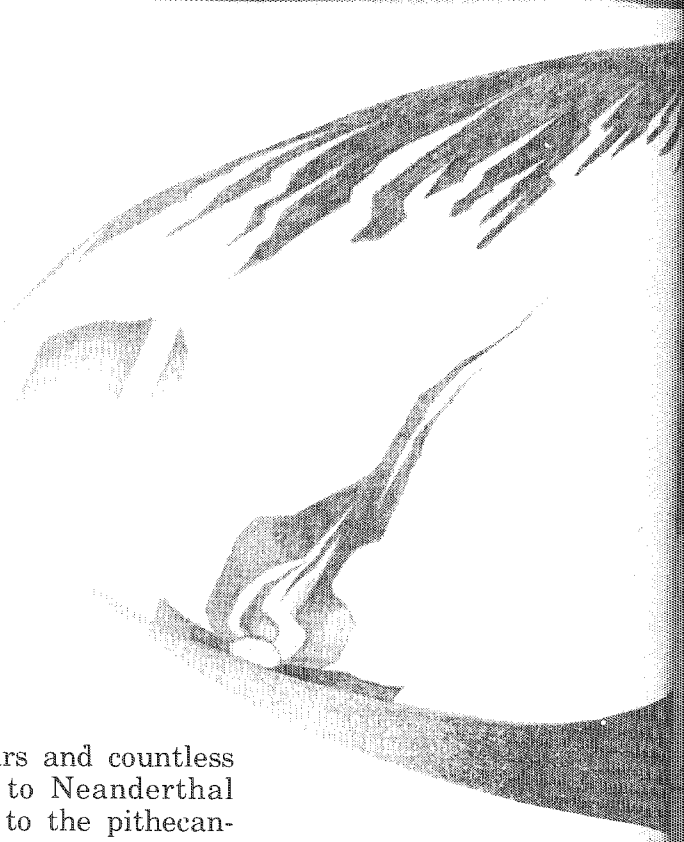
We are incapable of recollecting pleasures and pains of sense. It is impossible to reason concerning them, except by means of terms which have associated with them at the moment of their existence, and which are afterwards called up amidst trains of concomitant ideas.

When pleasures or pains are new or connected with new ideas, they can never be intelligibly detailed unless associated during their existence with terms standing for analogous feelings.

I have sometimes experienced from nitrous oxide, sensations similar to no others, and they have consequently been indescribable. This has been likewise often the case with other persons. Of two paralytic patients who were asked what they felt after breathing nitrous oxide, the first answered, *"I do not know how, but very queer."* The second said, *"I felt like the sound of a harp."* Probably in the one case, no analogous feelings had ever occured. In the other, the pleasurable thrillings were similar to the sensations produced by music; and hence, they were connected with terms formerly applied to music.

Gillray's drawing of Sir Humphry Davy lecturing at the Royal Institution, 1801. Sir Humphry Davy is holding the bellows. The Philosophical Magazine took note of the event: "Mr. Underwood experienced so much pleasure from breathing it that he lost all sense of everything else, and the breathing bag could only be taken from him at last by force."

THE PAWN



By Jon Nelson

I: 3051a

The still air of the cave smelled of urine and human stench. It was crowded inside of the small cave and extremely hot because of the huge burning fire in the center. Men, women and children sat around the fire and chanted in a low mumble; sweat rolled down their naked bodies.

The chanting stopped as the Ugly-One raised his small body up on a large rock. The people did not look up at his strange face.

They dreaded these gatherings. They would rather be out hunting for food and water. These meetings used up too much of their energy, of which they had little enough. Some of them already had telltale signs of starving.

But the Ugly-One had power—tremendous power that they feared. His word was law and he was speaking now.

He pointed outside the cave at the enviroment: At the scarce vegetation, few animals and dirty water; up at the sky where hard radiation was beginning to penetrate Earth's thin, polluted blanket of air. He growled the equivalent of BAD and the word burned in the minds of the people.

Then he conveyed a place of much vegetation and fresh water, of many animals and of fresh air. But the people around him did not care for his dreams. They wanted to hurry up and get the meeting over with.

The Ugly-One sensed this and he gave a command. The burning sensation in everyone's mind increased to the threshold of endurance as the Ugly-One channeled their raw psychic energy into himself and he began to trace the thread of Time back to the beginning of Man. He traced Earth's movement backwards in time and space, all the while recording Man's history. Further and further back he went—through three world wars and countless empires, back to Neanderthal man and even to the pithecanthropus.

And eventually, all of Mankind's history was stored in the collected minds of the people linked and controlled by the Ugly-One, enabling him to analyze it.

He sifted the data, checking each decision point in history following up the possible different courses of history resulting from which way each decision went, seeing if there was some way to change the past and alter the present, save his dying world.

The countless calculations took the Ugly-One's mutated, superior brain only twenty minutes to perform before he had arrived at a possible solution, one that would require a two-prong strategy.

II: 1964

"Single file." Sgt. Donald Kerber motioned the order to his squad as they moved deeped into the jungle. Despite the stifling heat and thickening of foliage and insects, his squad obeyed briskly.

They continued down the path as quietly as possible , their ears straining to hear the snap of a twig or some other sound of the enemy and their eyes always searching the jungle for a glimpse of him. Adrenalin pumped through them as even the jungle noise quieted down.

Sgt. Kerber was uneasy, exc tionally so. The blood pounded his ears and sweat rolled fre down his boyish face. In the b of his mind was a though. He t to grasp it, but couldn't.

There was a small clear ahead. It looked like a good p to ambush someone, thought S Kerber. But then, so did alm half of the jungle in Viet Nam raised his hand and the colum American soldiers slowed t pace.

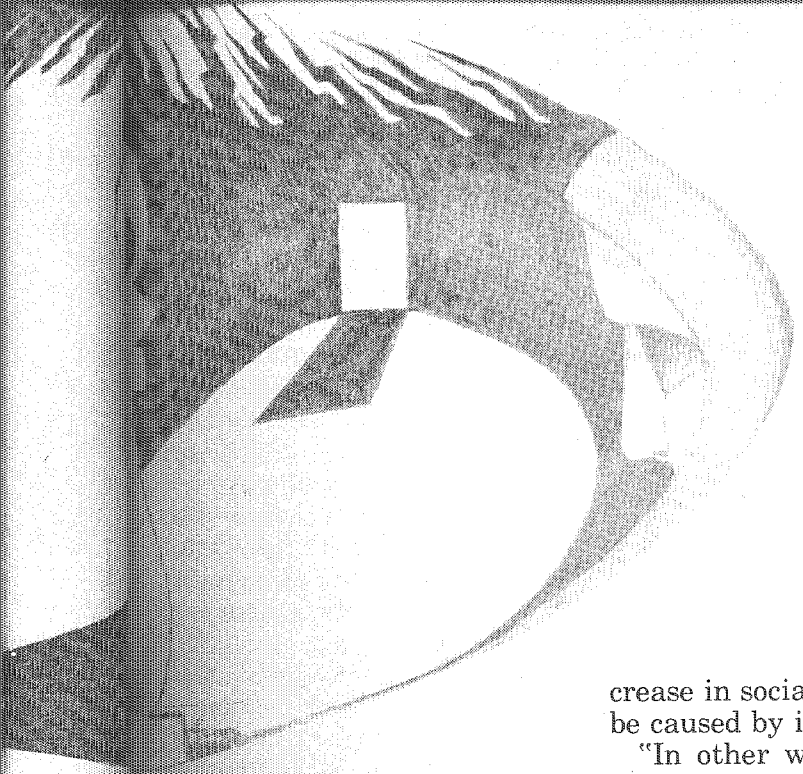
Somewhere a bird shriek and then there was silence ag Sgt. Kerber slowed his pace e more. The though in the bac his mind was drawing more tention than he would have li He looked about him—there no sign of the enemy. The cl ing was twenty yards ahead.

Just then, the thought in back of his mind hit him. W trained control, he acted quick

"Down!" he yelled. Bull sprayed the air above them ments after the squad had hit ground.

III: 3051b

The large man on throne stroked his white bear he listened to the young wo in front of him. Her name



Mira; she was his social advisor and had one of the sharpest minds in the Durian Empire.

"Your Highness," she said with a bow. She was tall and had long blond hair that fell to her shoulders. She was wearing the standard white tunic of the Emperor's court.

"Social entropy is increasing at an alarming rate within the Empire." If fact, she thought, it was only the greatness of the man in front of her, Emperor Vonar XI, that was holding the Empire together.

"Yes, yes I know. Please get to your point," said the Emperor. He knew about the social entropy which was eating away at his reign, but could do nothing to stop it. Breakdown of any form of order within a large group of people was inevitable.

"My point, your Highness," she began, "is that our time scanners have picked up a disturbance in the year 1964. Analysis shows that it will probably result in a sharp increase in social entropy within two days." Mira paused before beginning again. "The scanners also sense an impending disturbance in the year 1974. I do not think that our social structure will take the probable increase in social entropy that will be caused by it."

"In other words," said Vonar XI, "we may be thrown into a third Dark Ages unless something is done."

Mira nodded solemnly.

"What do you suggest should be done about it?" he asked.

"Well, your Highness, I have given the matter much thought and consideration and the only solution that I can arrive at is to use *qantora.* " At the mention of her last word, the Emperor's court let out a gasp.

Qantora had only been used before in Durian history. It was employed the day after the asassination of Vonar III to go go back a day in time and prevent killing. Because of time paradoxes, it wasn't recorded as part of factual history' but it was still remembered.

"Do you realize what you are saying?" asked Vonar XI. *Qantora* required the sacrificing of a highly intelligent person's life.

"Yes," said Mira, stoically.

"And whose life shall be sacrificed?" The Emperor sensed her answer.

"Mine. I would not have suggested it unless I was willing to make the sacrifice myself."

Emperor Vonar XI remained silent for a few moments, not looking into the eyes of the young woman in front of him. The court waited quietly for the answer, which finally came.

"So be it," said the Emperor. "*Qantora* will take place in one hour. The court is dismissed."

* * *

Mira took a final walk through the palace gardens. She had already said her good-byes. Now all that remained to be done was to go to the Imperial Chamber.

She spent her final moments of life taking in the beauty of the Earth she was about to leave: Brightly colored flowers scented the air, clear streams provided water for plants and animals, and the blue sky with big, fluffy white clouds. Mira thought that she would miss everything when she had gone.

The Imperial Chamber was located in the center of the palace. It was a large white dome usually used for private audiences with the Emperor's Council. In the center of the usually empty floor was a black sphere ten meters in diameter. When Mira arrived, she was led to the black sphere by the Emperor personally. Before he left, he broke the silence between them.

"Will you reconsider, Mira? Let someone else volunteer?"

"No, your Highness. I am doing what I feel is right."

"So be it. Good-bye, Mira. We will remember you," said Vonar XI. Then he left.

Qantora required the violent death of a person to release all of their psychic energy in a single burst. The energy is initially confined to the black sphere by the Council, six men and six women, until the person is able to draw his identity together again. He is then sent back in time.

Mira sat on a chair, in the black sphere, with her eyes closed. From behind her there was an explosion as her head was blown off by a small cannon.

For a moment, Mira did not feel anything. Then there was a single burst of pain and the freeing of her life energy. As the

Council held her energy to the sphere, Mira slowly drew herself back together again. When she was done, she existed in a pure energy form.

And then she went back in time to try and save the world in which she had lived.

IV: 1974

The New England breeze blew in from the Alantic as Don Kerber walked down the beach near his home. He pulled the collar of his windbreaker up around his neck as he climbed a rock overlooking the ocean. It would be dawn soon. He had spent the entire night walking the beach. It wasn't that he had insomnia, but there was something of great importance bothering him. And what was a bigger problem was that he didn't know exactly what it was.

There were several things that he didn't understand. In 1964 he had thought that his sixth sense had saved his life in Viet Nam. But when he had had it tested later, it was discovered that he didn't have enough ESP to be measured. That was a little strange.

But what was happening now was even stranger. He knew that he had no psychic powers, yet he was feeling the influence of two different forces on him. They were not the storybook good and evil forces, he sensed they were both good in their own way. But one wanted one thing and the other wanted just the opposite.

He remembered Dr. Goodman's theory of alternative universes and realized now that he was sorry that he hadn't heard all of it. It was too late now, though, since Dr. Goodman had died last year. But Don still remembered their conversations in 1971 . . .

"Uh, where was I, Kerber?" asked Dr. John R. Goodman, Head of the Physics Department.

"Alternative universes," answered Don Kerber. He disliked these faculty socials, but as a new professor at the University his attendance was required.

"Ah yes, now I remember." Dr. Goodman was a small man with a thinning white head of hair. He had been at Clark University for forty years. His only bad habit was a tendancy to drink too much. He took another sip from his third martini before starting. Don had a sneaky suspicion that most of the other faculty members had heard Dr. Goodman's pet theory before and now it was his turn.

"Well, to begin with, alternate universes are a sort of nicety, you might say. Their existance can't be proven directly, but they are a necessary part of our view of the universe. I don't suppose you have anything like that in Psychology?"

"You'd be surprised," replied Don, trying to find a way out of the upcoming lecture. There was none.

"Anyway, alternate universes must exist. Let me show you why." Dr. Goodman fumbled in his pocket and brought out a quarter. "If I was to flip this coin, there would be a fifty-fifty chance of it landing heads or tails. Right?"

Don nodded and Dr. Goodman continued.

"But in our universe, what actually happens is one hundred percent one way or the other. The coin either lands heads or tails."

Dr. Goodman flipped his coin and dropped it. He picked it up and tried again. This time he caught it.

"Mine landed heads. Do you see my point?" he asked.

Don acknowledged that he didn't.

"Why, it's obvious," exclaimed Dr. Goodman, gleefully. "There must have been an alternate universe just created in which my coin landed tails! Do you see now?"

"I think so." Don saw a ray of hope as his wife, Linda Mae, started to make her way toward them.

"What happens in our universe now," continued Dr. Goodman, "as a result of my coin landing hea and what happens now in the a ternate universe is a result of m coin landing tails. The two u verses had a common past until few minutes ago." Dr. Goodma was just getting started a Linda Mae had been side-track by Mrs. Miller.

"Now, if I had flipped this coi thousand years ago, the two u verses stemming from that de sion point would be differe today. For such minor decisio as the way a coin lands, I dou that they would be very differe But if it had been an importa decision point, well there is telling.

"Just think of the implicati of this theory, Kerber. Why oh, Mrs. Kerber, how do you d Dr. Goodman rose on uncerta legs as he greeted Don's wife.

"Dr. Goodman, so nice to you again. I'm terribly sorry interrupt your conversation wi Don, but we really must be le ing soon and we have to s good-bye to the Dean and wife." She gave Don a side wi He would thank her when t got home.

Of course," mumbled Goodman, disappointed. . .

Don felt that two futures, w 1974 a part of their common pa were now centering on him, some decision to go one way a the other future wanted it to the other. But what was the de sion?

He pondered on that until sun's rays told him that it time to go home. In the next ment, he heard an explosion turned to see his house in flam Linda Mae!!!

He started to run towards house, up the sandy path, then felt one of the forces slow down his pace by immobiliz certain muscles in his legs. found himself going slower slower. No! he thought, the de sion is my wife's life or death

He strained harder and ha against the force, trying to ge his wife, but only went slowe

was like a dream in which the harder he ran, the slower he went.

And then the other force entered into the battle, releasing the psychic holds that the Ugly-One had put on Don's legs. The Ugly-One attacked other muscles, but Mira countered by taking each of his holds off.

When Don arrived at his burning home, the Ugly-One tried one last gambit. As Don entered the door, he blocked the nerve impulses from Don's eyes to his brain, blinding him. Before Mira could react, a large piece of plaster fell and hit Don on the right shoulder. He fell to his knees as he regained his vision.

The wood paneling on the walls were giving off a thick smoke, which filled the entire downstairs. Don staggered to the stairway, avoiding other pieces of falling plaster. He called for his wife and heard a faint reply from the kitchen. Through the smoke and flames he found his way there. Smoke inhalation was burning his lungs. On the kitchen floor he saw his wife, still in her robe. He tried to lift her, but his right shoulder couldn't take the weight. Instead, he dragged her by the arms to the back door.

Somehow, he got the back door open and pulled his wife away from the burning house. The sound of nearing fire engines helped to clear his mind. The furnace must have exploded, he thought. The fresh air outside was making him cough. He looked down at his wife. Her face was covered with soot, but she didn't appear to have any burns. Yet she wasn't moving. Don bent down to listen for a heartbeat. Through the sound of the roaring flames and the fire engine sirens, he heard it.

V: 3051a

When the battle had ended, Mira found that she had to enter some life force or remain in a timeless oblivion forever. She reached out and merged with the nearest life energy— the Ugly-One.

As they travelled back to the Ugly-One's future, they allowed one another to search the other's mind, removing the need for further explanations. They returned as two minds in one body, each accepting the situation.

After the Ugly-One had released the people in the cave, he sat down to have a long talk with Mira.

"There are many things I can teach you," began Mira. "And now that this is my world also, I will help you to save it. We will find another decision point in history, but one that does not involve the life or death of someone.

"It will take getting used to, but I think that we will get along splendidly."

The Ugly-One looked at an oily pool of water in the cave, allowing Mira to look at her new body.

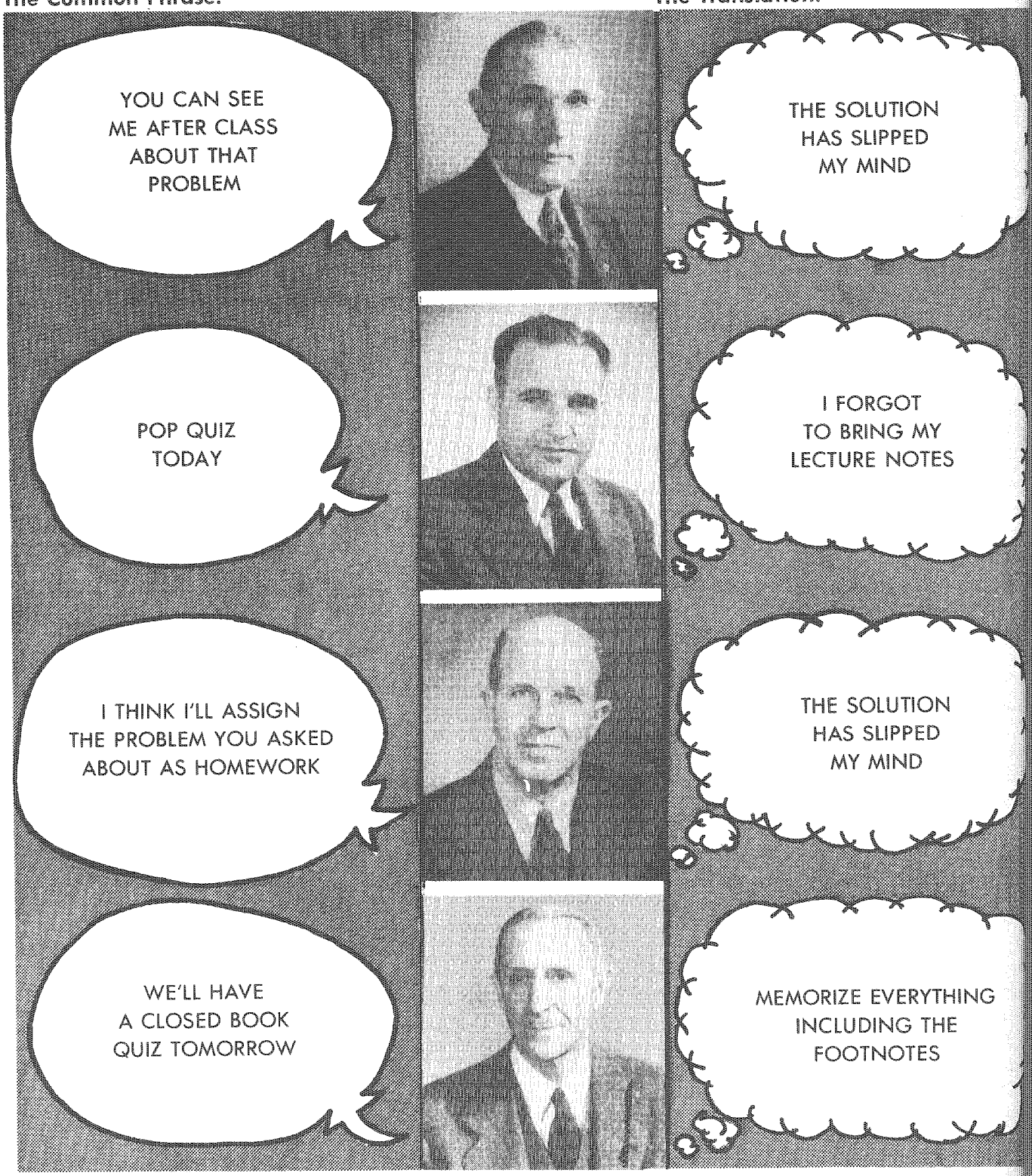
"There is something I want to tell you," said Mira, softly. "You are not ugly. You are a beautiful person."

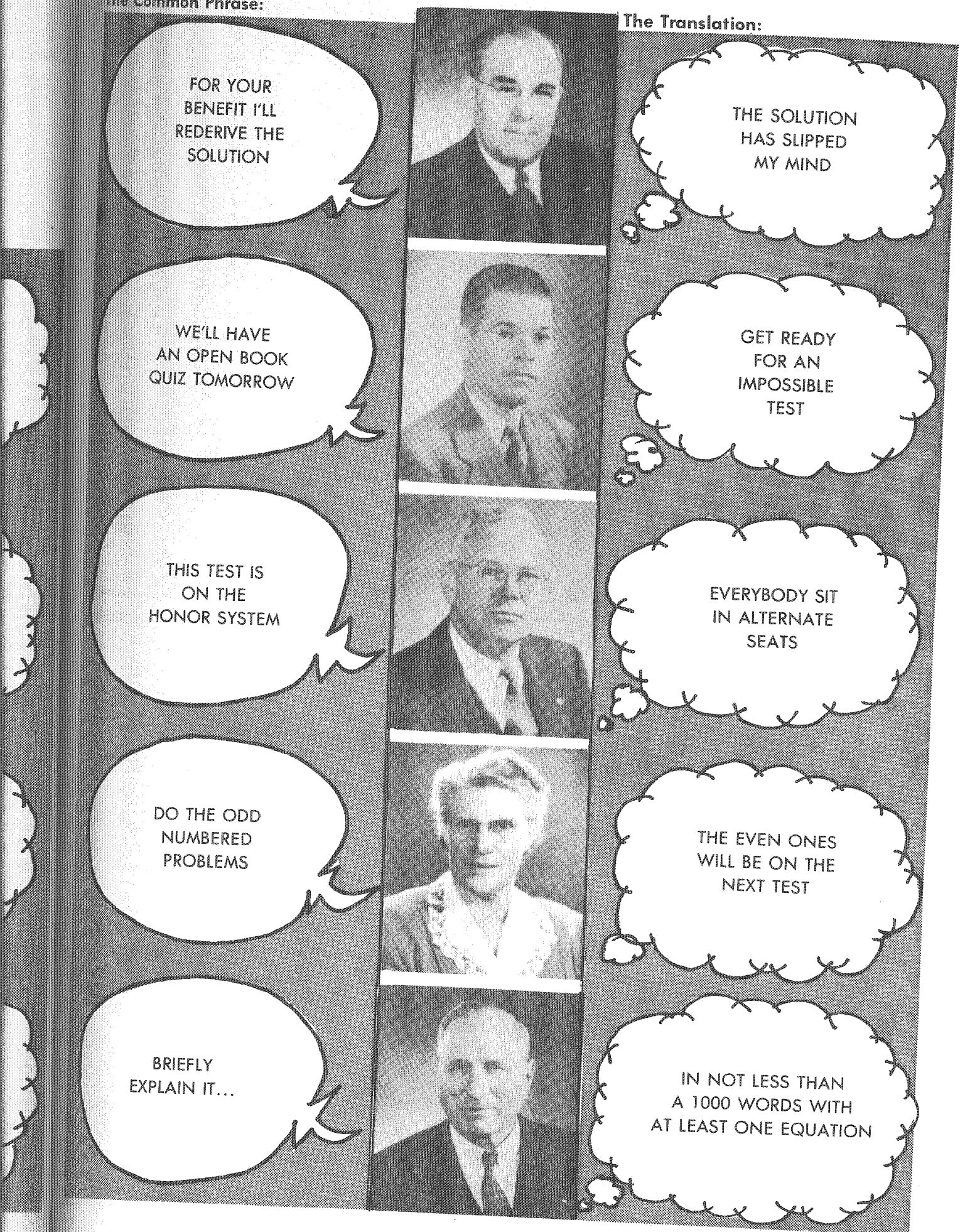
"As are you," he said after some thought. □

One transfer student that came to the University was irritated that it took him five weeks of his first quarter to learn that professors in IT talk in code. For example, he thought that a "quiz" was only a short ten minute test. So for everyone's clear understanding, the **Technolog** *is publishing translations to favorite phrases.*

A Professor-To-English Translator

The Common Phrase: | **The Translation:**




The Common Phrase:
The Translation:
FOR YOUR BENEFIT I'LL REDERIVE THE SOLUTION
THE SOLUTION HAS SLIPPED MY MIND
WE'LL HAVE AN OPEN BOOK QUIZ TOMORROW
GET READY FOR AN IMPOSSIBLE TEST
THIS TEST IS ON THE HONOR SYSTEM
EVERYBODY SIT IN ALTERNATE SEATS
DO THE ODD NUMBERED PROBLEMS
THE EVEN ONES WILL BE ON THE NEXT TEST
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IN NOT LESS THAN A 1000 WORDS WITH AT LEAST ONE EQUATION

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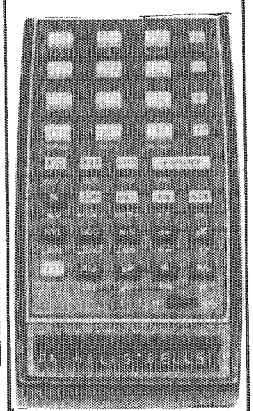

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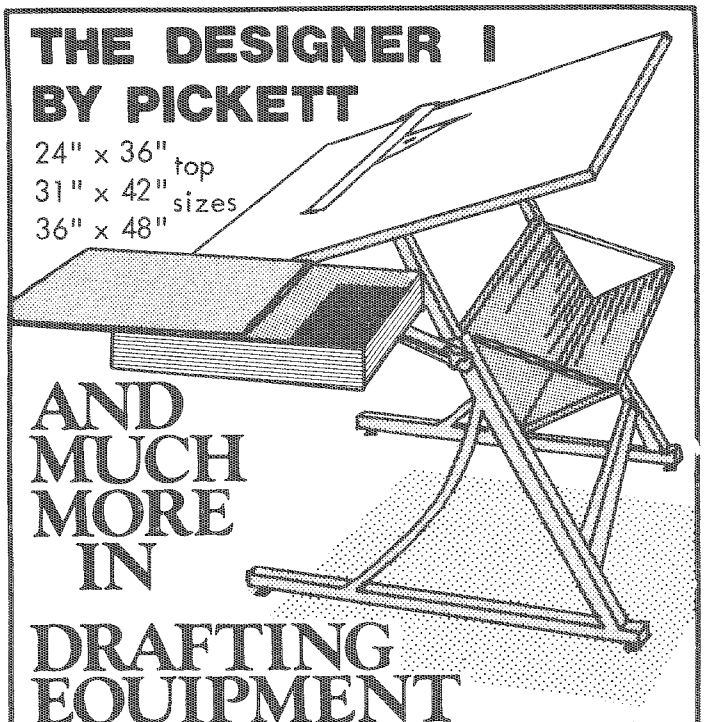

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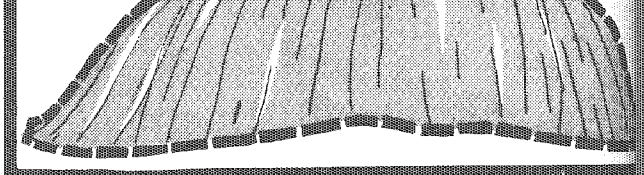
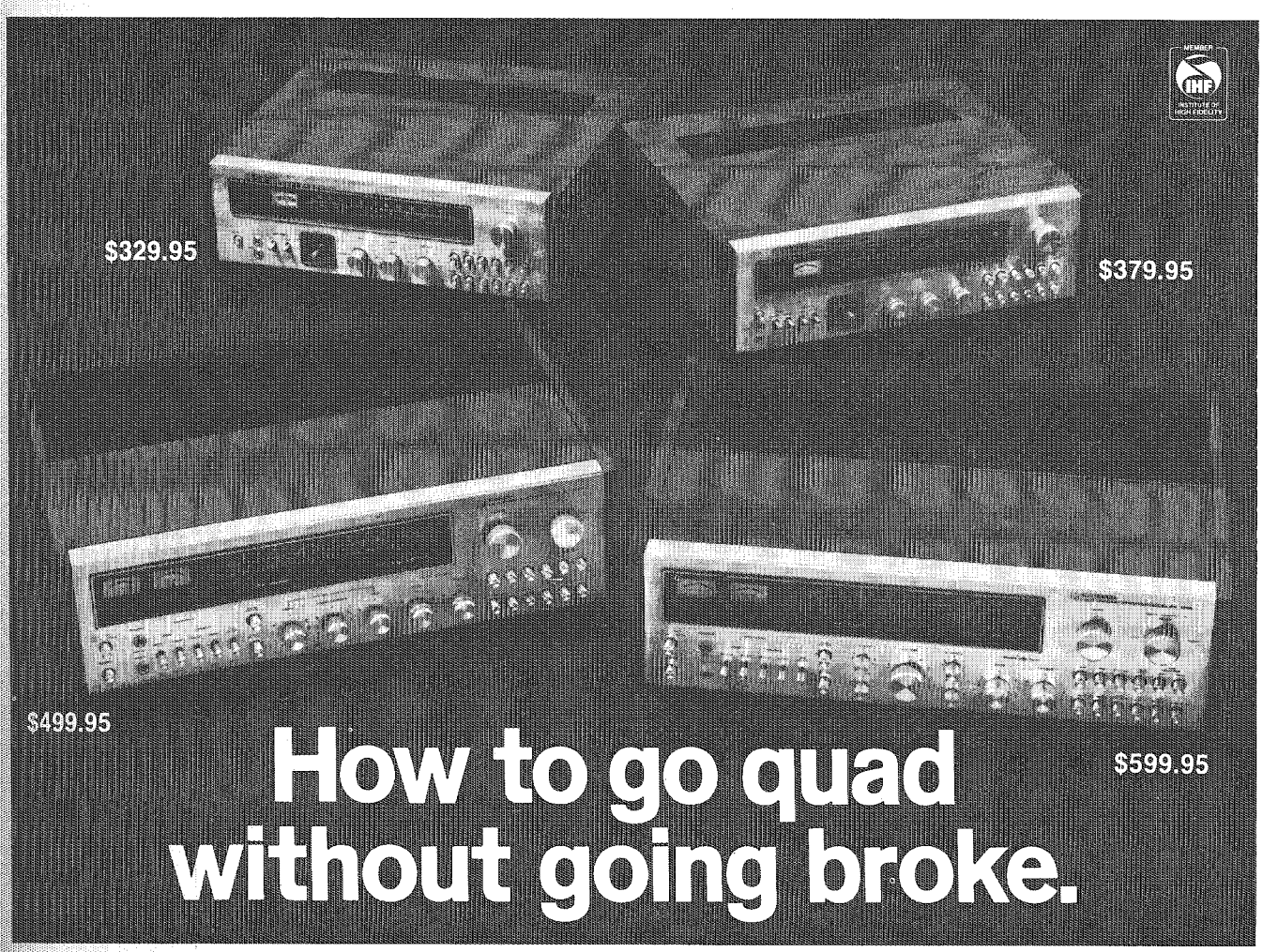
A Technolog Special:

Dean Cartwright Mustache Cut-Out

About ten years ago, Uncle John Pancake houses gave out cardboard Uncle John mustaches for kids to wear. Since engineering students never outgrow their childhood, (for example, look at all those civils playing with their erector sets) the **Technolog** has come up with a new Dean Cartwright mustache! So here it is folks! Your very own Dean Cartwright mustache!!





How to go quad without going broke.

The trick is to find a high-quality quad receiver at a low price.

We think we have that receiver. In fact, we think we have four of them, each one an outstanding buy within its price category. They're all listed below with their prices and most important specs. All you have to do is decide which one is best for you.

$329.95* 4 x 7.5 watts continuous (RMS) power into 8 ohms from 30Hz to 20kHz at less than 1% total harmonic distortion. 2 x 15 watts continuous (RMS) power in special stereo bridge mode. IM distortion at rated continuous output is less than 1%. Frequency response is 20Hz-20kHz at tape input ± 1.5 db. An exceptional FM sensitivity of 2.3 μv. Plus many features. Model RQ 3745.

$379.95* 4 x 15 watts continuous (RMS) power into 8 ohms from 20 Hz to 20kHz at less than 1% total harmonic distortion. 2 x 30 watts continuous (RMS) power in special stereo bridge mode. IM distortion at rated continuous output is less than 1%. Frequency response is 20Hz-20kHz at tape input ± 1.5db. FM sensitivity of 2.3 μv. Plus many features. Model RQ 3746.

$499.95* 4 x 25 watts continuous (RMS) power into 8 ohms from 20Hz to 20kHz at less than 0.5% total harmonic distortion. 2 x 60 watts continuous (RMS) power in special stereo bridge mode. IM distortion at rated continuous output is less than 0.5%. Frequency response is 20Hz to 30kHz at tape input ± 1.5db. FM sensitivity is an exceptional 1.9 μv. Full function jack panel. Walnut veneer cabinet. Plus many other features. Model RQ 3747.

$599.95* 4 x 50 watts continuous (RMS) power into 8 ohms from 20Hz to 20kHz at less than 0.5% total harmonic distortion. 2 x 125 watts continuous (RMS) power in special stereo bridge mode. IM distortion at rated continuous output is less than 0.5%. Frequency response is 20Hz to 30kHz at tape input ± 1.5db. Outstanding FM sensitivity of 1.9 μv. Full function jack panel. Walnut veneer cabinet. Plus many other features. Model RQ 3748.

If you like what you see and what you read, go to your Sylvania dealer. When you're there, you'll like what you hear.

*Manufacturer's suggested retail price.

GTE SYLVANIA

Development and Design. Is this the kind of engineering for you?

Trying to figure out the exact kind of engineering work you should go into can be pretty tough.

One minute you're studying a general area like mechanical or electrical engineering. The next you're faced with a maze of job functions you don't fully understand. And that often are called different names by different companies.

General Electric employs quite a few engineers. So we thought a series of ads explaining the work they do might come in handy. After all, it's better to understand the various job functions before a job interview than waste your interview time trying to learn about them.

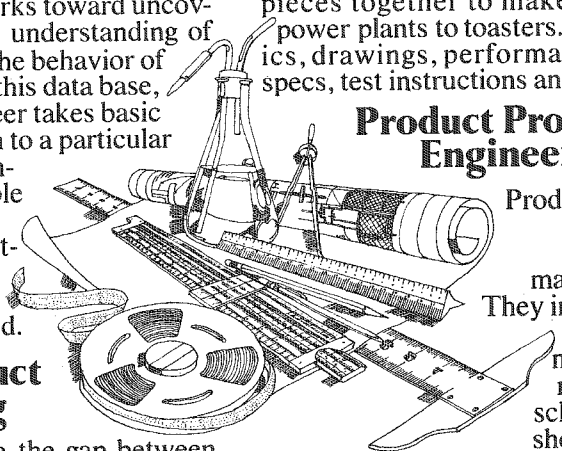
Basically, engineering at GE (and many other companies) can be divided into three areas. Developing and designing products and systems. Manufacturing products. Selling and servicing products.

This ad outlines the types of work found in the Development and Design area at GE. Other ads in this series will cover the two remaining areas.

We also have a handy guide that explains all three areas. For a free copy, just write: General Electric, Educational Communications, W1D, Fairfield, CT 06431.

Basic/Applied Research Engineering

Motivated by a curiosity about nature, the basic research engineer works toward uncovering new knowledge and understanding of physical phenomena (like the behavior of magnetic materials). From this data base, the applied research engineer takes basic principles and applies them to a particular need or problem (such as increasing the energy available from a permanent magnet). Output is aimed at a marketable item. Both work in laboratories and advanced degrees are usually required.



Advance Product Engineering

Advance engineers bridge the gap between science and application. Their job is to understand the latest advances in materials, processes, etc., in a product area, then use this knowledge to think up ideas for new or improved products or to solve technical problems. They must also prove the technical feasibility of their ideas through laboratory testing and models. Requires a highly creative, analytical mind. A pioneering spirit. And a high level of technical expertise. Output is often a functional model.

Product Design Engineering

Design engineers at GE pick up where the advance engineer leaves off. They take the product idea and transform it into a product design that meets given specs and can be manufactured. Usually, they are responsible for taking their designs through initial production to prove they can be manufactured within cost. Requires a generalist who can work with many experts, then put all the pieces together to make a product. From power plants to toasters. Output is schematics, drawings, performance and materials specs, test instructions and results, etc.

Product Production Engineering

Production engineers interface between the design engineer and manufacturing people. They interpret the product design intent to manufacturing. They maintain production scheduling by trouble-shooting during manufacturing and determining deviations from specs. When necessary, they help design adaptations of the product design to improve quality or lower cost without changing the essential product features. Requires intimate familiarity with production facilities.

Engineering Management

For people interested in both engineering work and management. Engineering managers plan and coordinate the work of other engineers. They might oversee product development, design, production, testing or other functions in marketing and manufacturing. Requires a strong technical base gained through successful engineering work. Sensitivity to business factors such as cost and efficiency. Plus the ability to work with people.

GENERAL ELECTRIC

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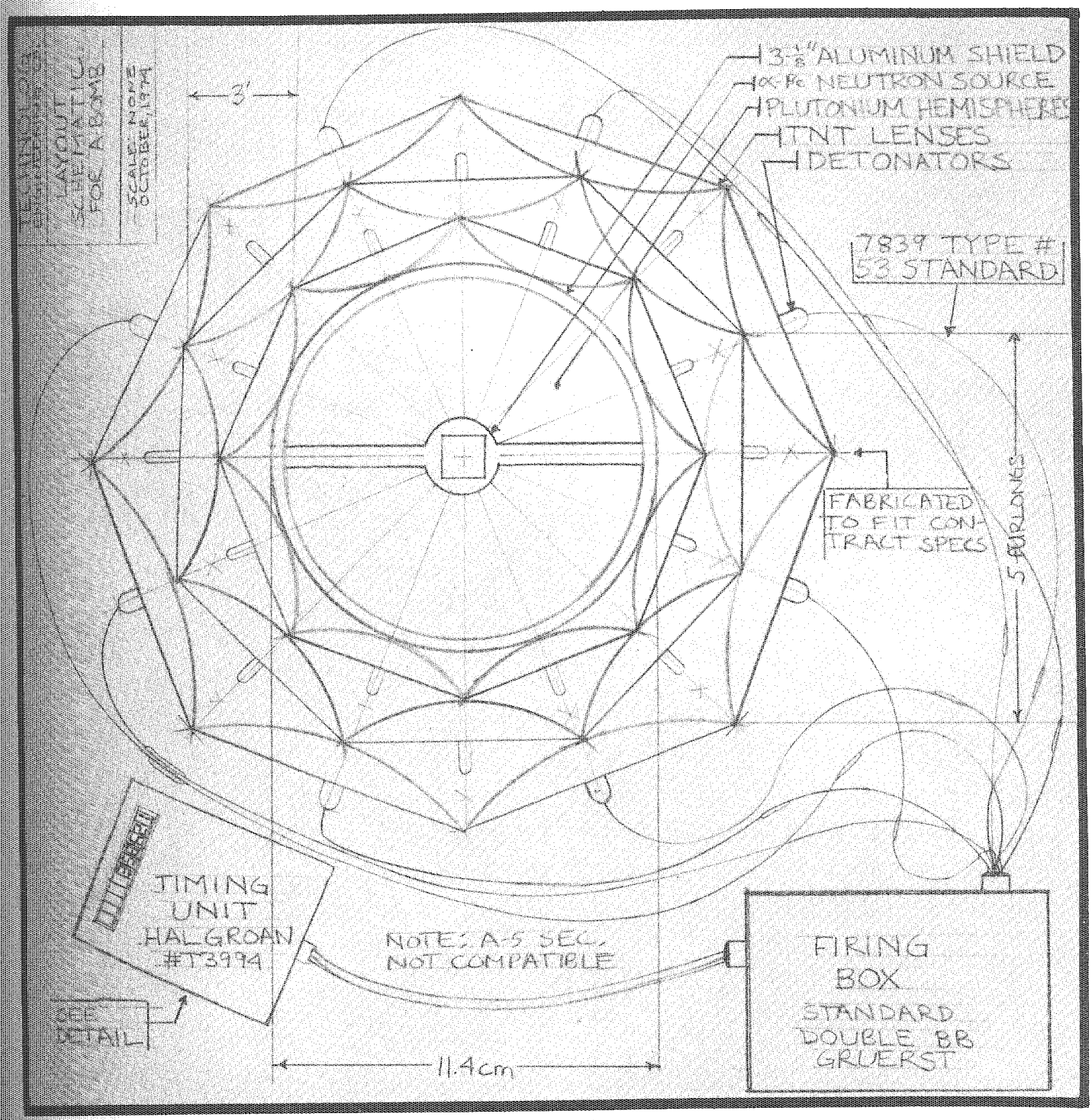
minnesota **Technolog** november 1974

BUILD YOUR OWN ATOM BOMB

THE TRUE STORY: FORESTERS' HEADQUARTERS



Some people are starving for more than a passing grade in English.

Many people we know couldn't stomach what some college students eat in one day.

Luke warm coffee.

Peanut butter on crackers.

Beer.

Two chocolate bars.

And a hamburger.

But for millions even this epicurean nightmare would be a welcome feast. It's no secret, hunger is one of the major problems facing many people in the world.

And helping nations produce more food is something FMC can do very well.

We can engineer giant land reclamation programs.

To increase agricultural production we make machines that prepare the soil and plant the seeds, enabling large acreages to be worked efficiently.

To protect the crop from pests and disease we produce special agricultural chemicals, such as Furadan®, an insecticide-nematocide that's boosting the yields of rice, alfalfa, corn, peanuts and sugarcane.

We make mechanical harvesters for special crops such as tomatoes, corn, peas and beans and to help make low-cost food possible, we make automatic food canning and freezing equipment.

We even design machines to form and fill bags and boxes, and manufacture many types of transparent films for packaging.

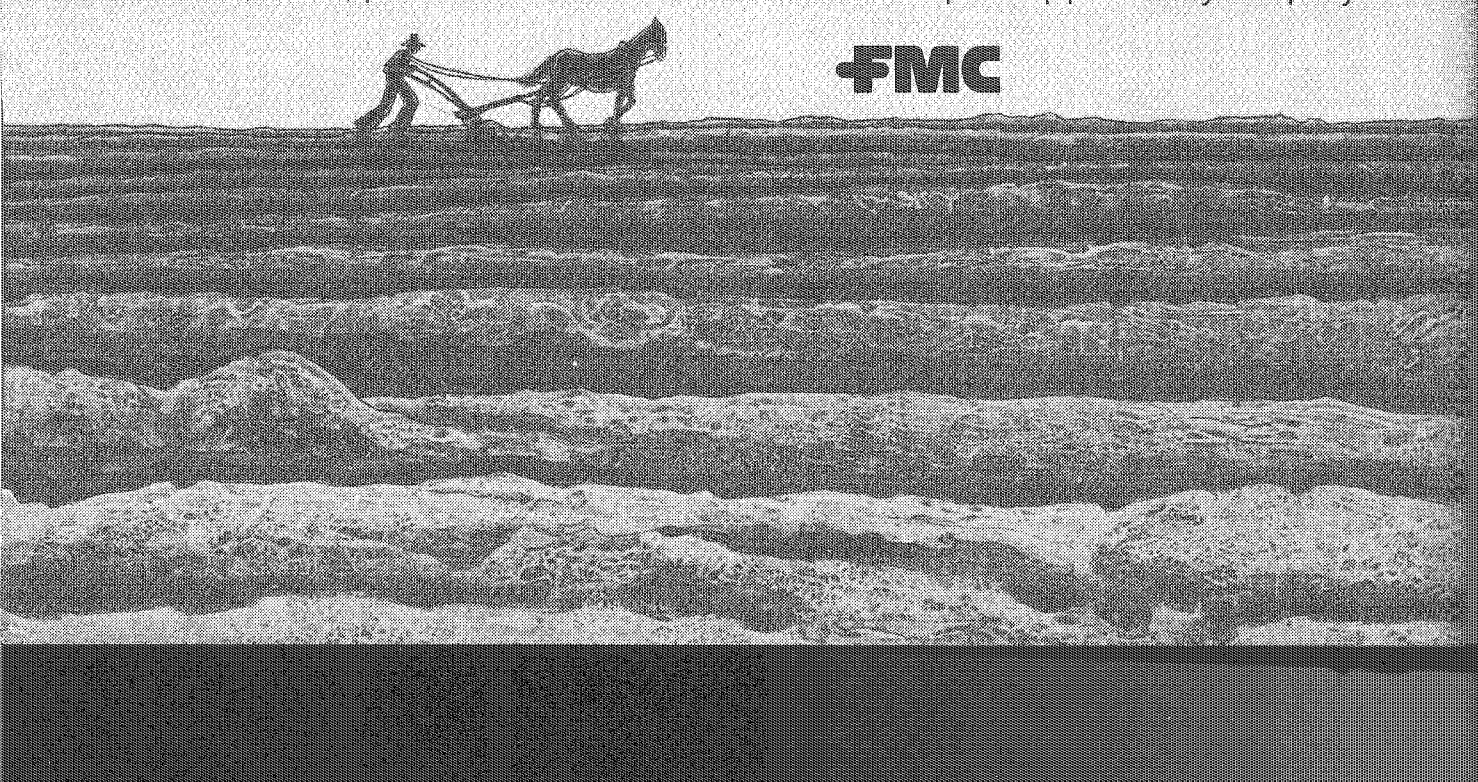
And while we don't have the final solution to the hunger problem, we do offer more ways and means of growing, harvesting, processing and packaging food than any other single company in the world.

Helping to feed hungry people is one of our major concerns, but it's not our only concern. We are also into pollution control equipment, fibers, cranes, material handling systems, power transmission equipment and much more.

See us on campus or write for further information.

FMC Corporation, 200 East Randolph Drive, Chicago 60601. An Equal Opportunity Employer.

FMC



SYLVANIA'S FLAT RESPONSE TO HIGH PRICES.

ANNOUNCING THE NEW SUPER AS 210 A. ONLY $99.95*.

Our new speaker gives you a power frequency response that's flat (±3db) all the way from 33Hz to 15,000 Hz.

Your ears will also be grateful for what it *doesn't* give you.

There's no bass boom acting as a poor substitute for good low-end response.

There are no high-frequency peaks providing phony brilliance at the treble end.

In sum: no exaggeration of highs or lows.

How did we do it?

By making significant improvements in a two-way ten-inch—one of the most thoroughly researched speakers.

You get a deluxe 10″ woofer with a powerful 1-lb., 9-oz. ceramic magnet. A 1½″ voice coil epoxy-bonded to the speaker cone for outstanding power handling. A 1½″ Mylar dome mid/tweeter with a hefty Alnico V magnet. Sealed air-suspension, of course. And much more.

What you hear is an extremely accurate copy of the original audio input.

At $99.95, we think you'll find that our SUPER AS 210 A is one of the best values on the market today.

For details, see your Sylvania dealer. Or write to: GTE Sylvania, 700 Ellicott St., Batavia, N.Y. 14020.

*Manufacturer's suggested retail price.

GTE SYLVANIA

now that you have an engineering degree, we'd like to offer you an engineering career.

Sargent & Lundy's entire business is engineering and engineering is exactly what we would hire you to do. We are the nation's largest consulting and design engineering firm and specialize in projects for the electric utility industry. The industry and ourselves are growing continuously and we have an increasing need for graduates with bachelor and advanced degrees in many engineering disciplines.

If an engineering career is your plan, we would like to talk with you. Please make an appointment through your placement office to interview with us. Our company representative will be on the Minnesota campus, January 24, 1975.

Ronald C. Haglind, B.S., 1968, M.S., 1973, Mechanical Engineering, University of Minnesota. Presently, supervisor, project analysis section, Mechanical Analytical Division.

"I think your time would be well spent by talking to Sargent & Lundy. Here, I'm not only asked, but allowed to do the work I trained myself to do."

SARGENT & LUNDY
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minnesota **Technolog** Fall[2]

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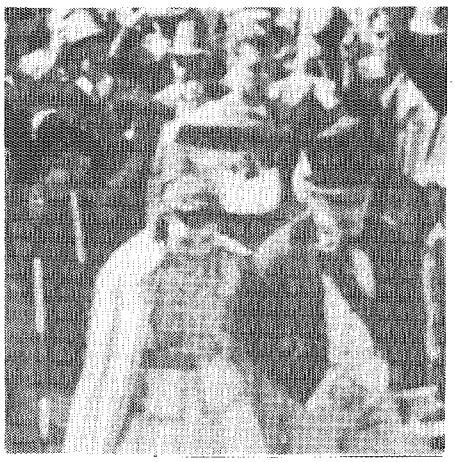
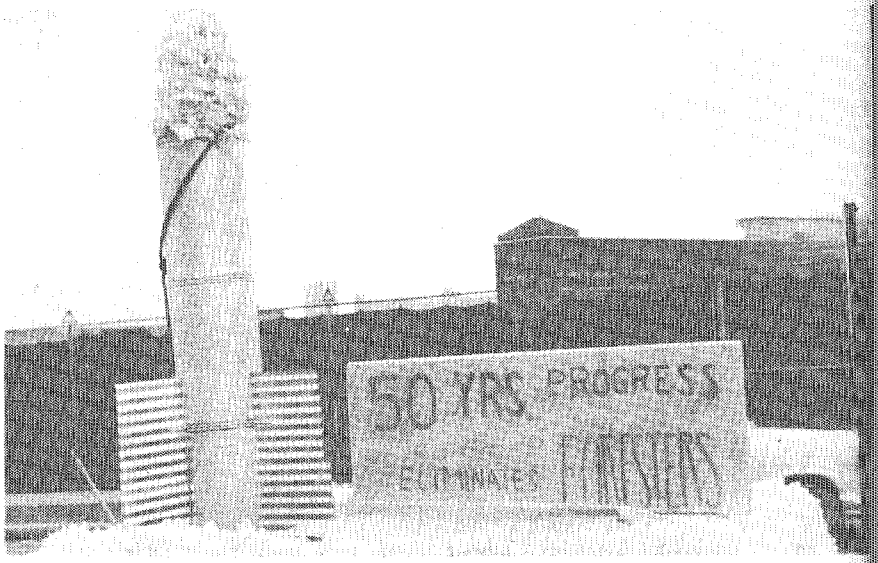
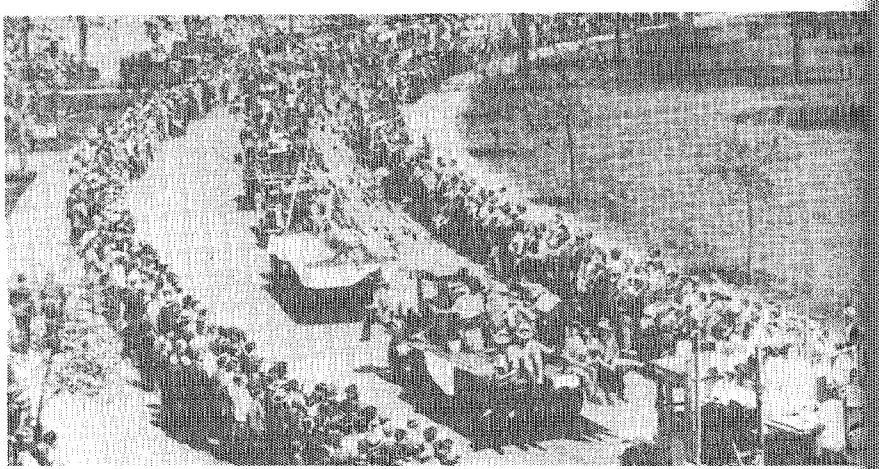
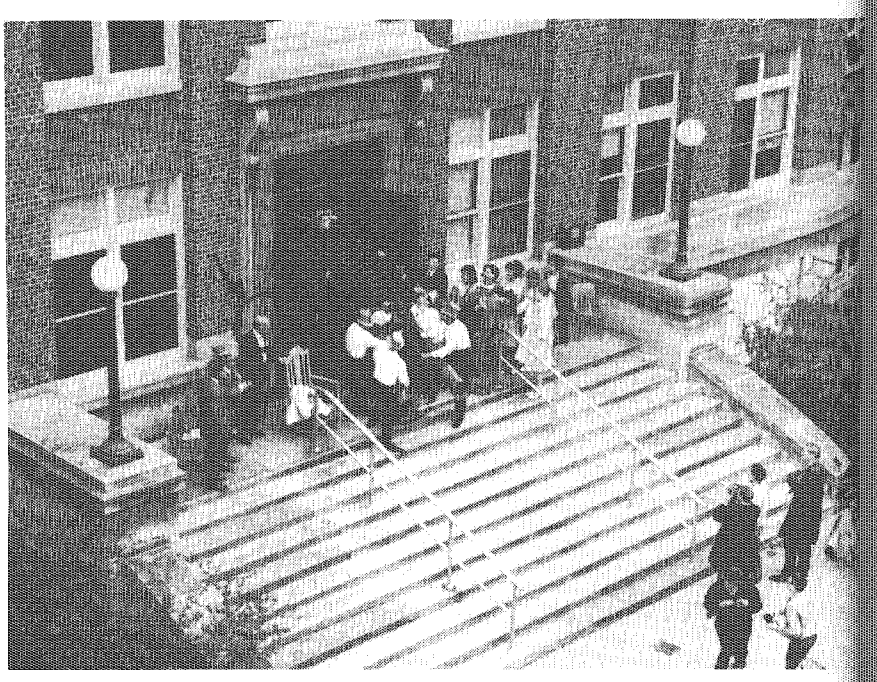
Technolog









Let's Get E-Week Going: E-Day, traditionally engineers' annual fling, fell on its face last year due to poor planning. The I.T. Board and the Technolog have promised to help organize a dynamite E-Day this year. Hopefully, PlumbBob feels the same way.

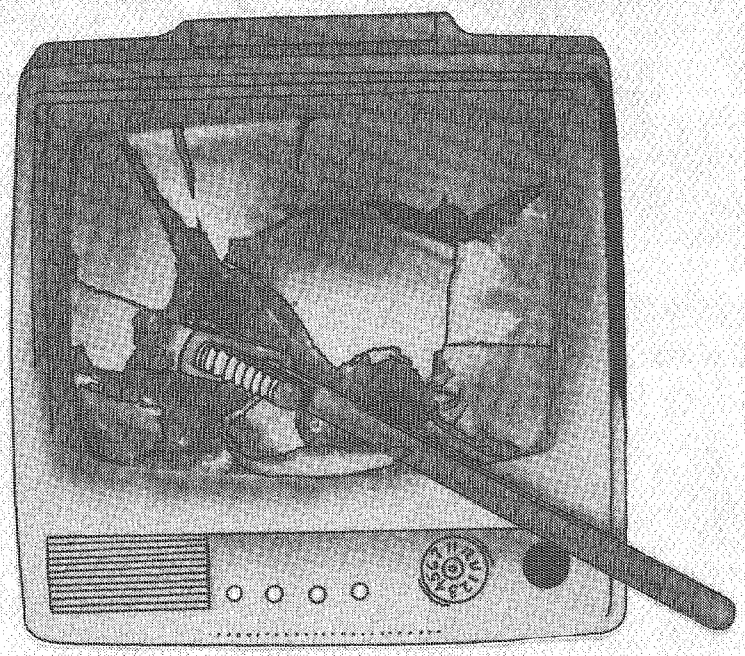
Pictured on this page are some pictures from some past E-Days.

A-Bomb: Several mass media outlets have reported on the possibility of building your own atom bomb. The *Technolog* assigned a reporter to determine if this could be done by a University student. We even have several people trying to design one. Preliminary results are in this issue. We do not think that this is a good way to spend your time, rather we are trying to bring up the spine tingling fact that it is darn easy to come up with an A-Bomb design.

I.T. Apathy: I.T. students are often accused of school spirit apathy. Even though this is true in some cases, many I.T. students are very involved with their school.

This issue we have a listing of all formally organized I.T. organizations and extracurricular activities. As the year gets going we hope to publish more on what the different groups have been accomplishing.

editorials



Marcus Welby: The ABC Television Network and its local affiliate, KMSP (Channel 9), were irresponsible in showing a recent segment of the *Marcus Welby M.D.* series which depicted the rape of a male junior high school student by his male science teacher. Censorship is not the issue; no one questions their *right* to broadcast the episode. But television has immense power to stir people's emotions, and it must realize that with freedom and power comes responsibility to refrain from encouraging sensationalism at key times when rational thought and discussion are necessary.

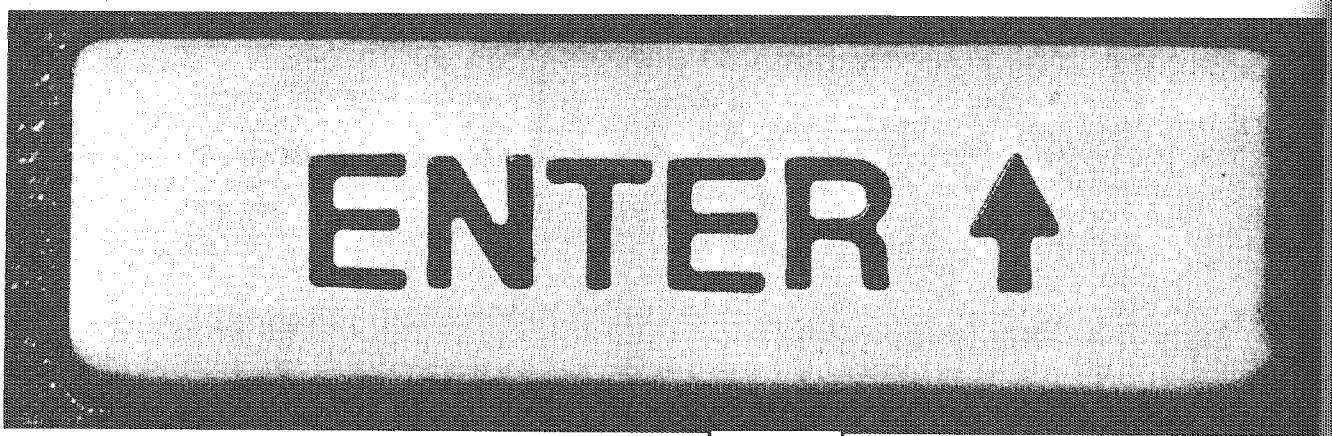
The objectional element of the program was its basic situation. The rape of a school boy by his teacher, regardless of how the characters in the program react, would remain blatant sensationalism. No matter how much the script might be watered down, most of the viewers will react with intense emotion. They will jump to the conclusion that the attacker was homosexual (which might not be the case—most child molesters do not care which gender the child is) and they will generalize to conclude that most Gay teachers are a menance to their children. (Judging from the thousands of secretly gay teachers and professors who have taught virtually without incident for decades, they obviously present a danger to no one.)

Consider a parallel situation. Suppose a national network and its local affiliate planned to show a program in which a massive radiation leak occured as a result of an accident in a nuclear power plant, resulting in widespread death and suffering. Suppose power companies across the country were applying for permits to build nuclear plants at the time of the broadcast. The public already feared nuclear power; any number of experts could tell how unlikely such a massive leak would be, but the public would be deaf to facts. In the name of drama (and freedom to broadcast), the network would have used an exceedingly improbable situation to play on the irrational fears of the public with the result that immense pressure would arise to deny the permits.

The situation here is remarkably similar. Many parents already have an intense fear that their children will be raped. Male-male rape is rare to begin with and, when it does occur, it is rarely by a teacher against a student; yet once the issue is enflamed, facts make little difference. With legislation pending in Minnesota and elsewhere which would extend fair employment laws to protect Gay people, the *Marcus Welby* program encourages irrational fear rather than rational, objective deliberation which should accompany any legislative decision.

Television programs need not exploit and enflame people's fears about extremely unlikely events to be entertaining. With legislation pending affecting fundamental human rights, broadcast of that program was more than unnecessary, it was nothing short of irresponsible.

Richard A. Davis



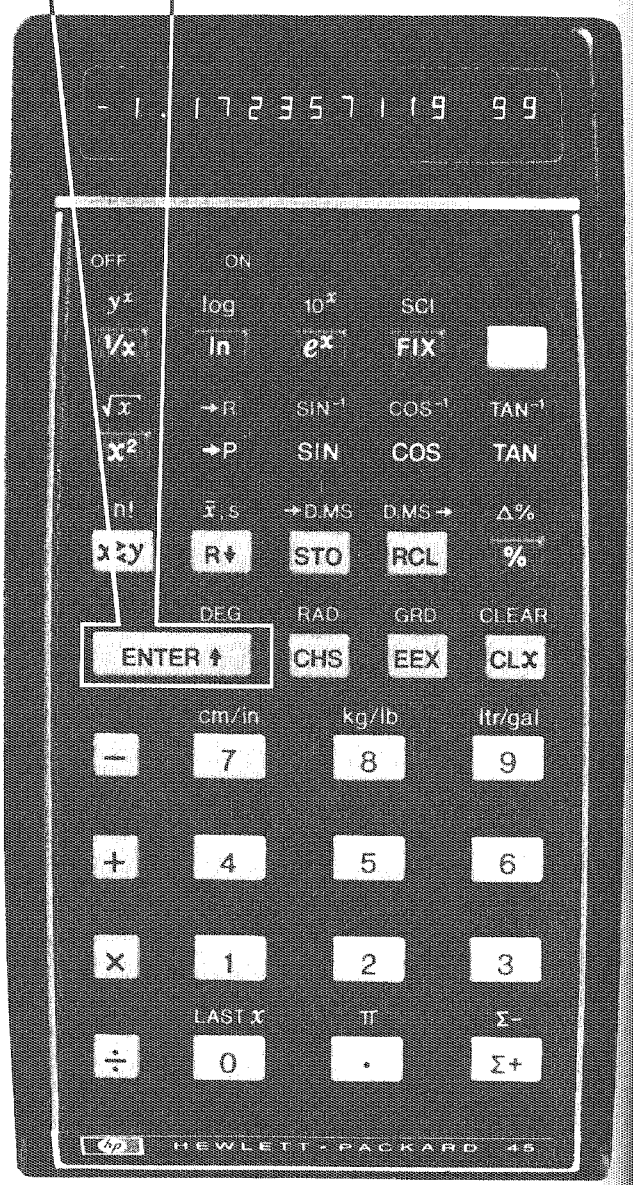
This is your key to unprecedented calculating power. Only Hewlett-Packard offers it.

In 1928 a Polish mathematician, Dr. Jan Lukasiewicz, invented a parenthesis-free but unambiguous language. As it's evolved over the years it's come to be known as Reverse Polish Notation (RPN), and it's become a standard language of computer science.

Today, it's the only language that allows you to "speak" with total consistency to a pocket-sized calculator. And the only pocket-sized calculators that use it are Hewlett-Packard's

ENTER↑ is the key to RPN because it enables you to load data into a 4-Register Operational Stack with the following consequences:

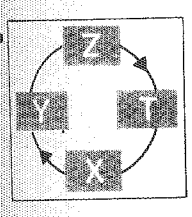
1. You can *always* enter data the same way, i.e. from left to right, the natural way to read any expression.
2. You can *always* proceed through your problem the same way. Once you've entered a number you ask: "Can I operate?" If yes, you perform the operation. If no, you press ENTER↑ and key in the next number.
3. You can see *all* intermediate data anytime, so you can check the progress of your calculations *as you go.*
4. You almost never have to re-enter intermediate answers—a real time-saver, especially when your data have eight or nine digits each.
5. You don't have to think your problem all the way through beforehand to determine the best method of approach.
6. You can easily recover from errors since each operation is performed sequentially, immediately after pressing the appropriate key, and all data stored in the calculator can be easily reviewed.
7. You can communicate with your calculator efficiently, consistently and without ambiguity. You always proceed one way, no matter what the problem.



The HP-45 uses RPN.

That's one reason it's the most powerful pre-programmed pocket-sized scientific calculator. Here are 8 others:

1. It's pre-programmed to handle 44 arithmetic, trigonometric and logarithmic functions and data manipulation operations beyond the basic four (+, −, ×, ÷).

2. 

It offers a 4-Register Operational Stack that saves intermediate answers and automatically retrieves them when they are required in the calculation.

3. It lets you store up to nine separate constants in its nine Addressable Memory Registers.

4. It gives you a "Last X" Register for error correction or multiple operations on the same number. If you get stuck midway through a problem, you can use the "Last X" Register to unravel what you've done.

5. SCI FIX It displays up to 10 significant digits in either fixed-decimal or scientific notation and automatically positions the decimal point throughout its 200-decade range.

6. →D.MS STO D.MS→ RCL It converts angles from decimal degrees, radians or grads to degrees/minutes/seconds and back again.

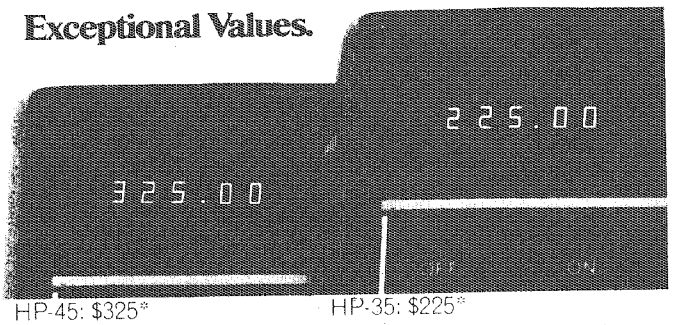
7. →R →P It converts polar coordinates to rectangular coordinates... or vice-versa. In seconds.

8. Its Gold "Shift" Key doubles the functions of 24 keys which increases the HP-45's capability without increasing its size.

The HP-35 uses RPN too.

If the HP-45 is the world's most powerful pre-programmed pocket-sized scientific calculator, the HP-35 is runner-up. It handles 22 functions, has a 4-Register Stack, one Addressable Memory Register and also displays up to 10 digits in either fixed-decimal or scientific notation.

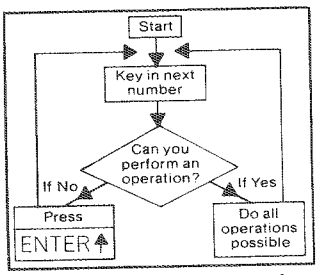
Exceptional Values.



HP-45: $325* HP-35: $225*

The exceptional value of these exceptional machines becomes even more apparent when you consider their prices. You can own the world's most powerful pocket-sized pre-programmed scientific calculator, the HP-45, for just $325.* The HP-35 costs only $225.*

Ask your dealer for our booklet, "ENTER vs. EQUALS."



It demonstrates the superiority of Dr. Łukasiewicz' language by comparing it to other calculators' systems on a problem-by-problem basis, and it explains the algorithm shown to the left which lets you evaluate any expression on a calculator that uses RPN and an Operational Stack. This booklet is must reading for anyone seriously interested in owning a powerful pocket-sized calculator.

Available at leading department stores and college bookstores.

Stop in for a free copy of "Enter vs. Equals," detailed specifications on either the HP-35 or HP-45 and demonstrations of both machines. Call Hewlett-Packard Customer Service, (408) 996-0100 for the dealer nearest you.

Ask about our HP-65 and HP-70 while you're there.

Chances are, he'll also have our two newest pocket calculators on display—the fully programmable HP-65 that lets you write, edit and record programs on magnetic cards and the HP-70 business calculator that can help all business students to excell in their business courses.

A Hewlett-Packard pocket calculator can help you in school today, on the job tomorrow.

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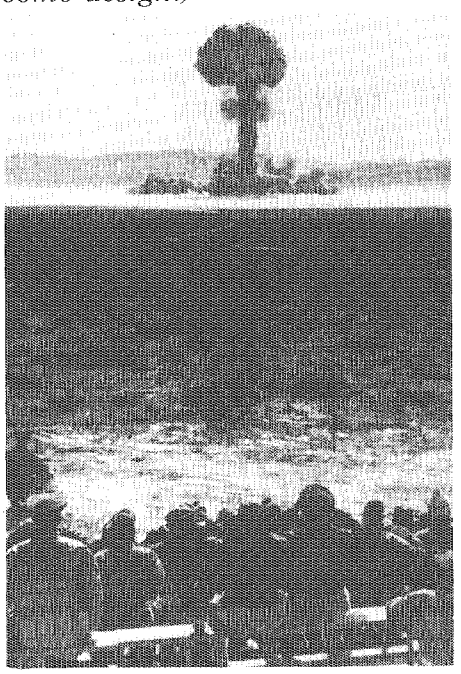
other words, a dud. But if you have enough mass around the fissionable material, its inertia will hold the critical mass together long enough for a lot of the uranium or plutonium atoms to fission. The more atoms that fission, the higher the yield of the bomb and the more efficient it is. The critical mass for uranium-235 with several centimeters of steel around it to hold it together and to act as a reflector is about 20 kilograms. If one kilogram of uranium-235 fissions completely, the energy released is equivalent to 20,000 tons of TNT.

Another problem with making a bomb is that you have to bring the subcritical masses together very rapidly. If the pieces, say of plutonium, are brought together too slowly, some of the plutonium will fission and the thermal energy will drive the pieces apart, another fizzle yield. High explosives are used to drive the subcritical pieces into a critical mass. *The Los Alamos Primer,* available from the Atomic Energy Commision for $2.06, and *Manhattan District History, Project Y, the Los Alamos Project,* available from the Office of Technical Services of the United States Department of Commerce for $4.00, will give you a lot of ideas on how to approach the technical problems of bomb design.

The people of the Manhattan Project spent a lot of time discovering how to handle uranium and plutonium. But all you have to do is go to *The Reactor Handbook* and *The Metal Plutonium,* by A.S. Coffinberry and W.N. Miner (which isn't in the Engineering Library) to find out how to handle those metals. Those books will also give you an idea of chemical equipment you'll need and the safety precautions you'll need to take.

Materials, except for the fissionable material, can be legally purchased at industrial supply houses and equipment can be purchased through scientific catalogs. You or your cohorts would need skills in machining, chemical handling, and explosives. (*Editor's note: Several I.T. students that have these skills are researching and designing an A-bomb. A later issue of this magazine will carry some of their results to try and determine more precisely what materials, equipment and skills would be required for a specific bomb design.)*



So, the myth of nuclear power no longer protects us and the word is out on how to build an atomic bomb. That leaves only the availability of fissionable materials between society and nuclear terrorism.

Although uranium-235 can be fashioned into a simple atomic explosive more easily than plutonium, it is not likely to be much of a problem. Uranium fuel for the nuclear power plants now in use is not rich enough in uranium-235 to be used in a bomb.

But the nuclear industry will probably run out of uranium around the year 2000, depending on the rate of growth of nuclear power and the price utilities are willing to pay for uranium. Plutonium, which can also be used to fuel nuc power plants, is produce small quantities in conventi nuclear reactors and wil produced in large quantitie breeder reactors. O plutonium, rather t uranium-235 becomes the n fuel for nuclear power, the n lear industry can continu operate far beyond the y 2000.

However, the nuclear ind try as it is currently develo involves a lot of transportin uranium and plutonium. I fabrication plants, nuclear r tors, and reprocessing pla are separated by hundred miles.

Transportation is a weak l in the security of shipping n commercial products, inclu plutonium and uranium. Sm amounts of plutonium co also be diverted over a l period of time from fuel re cessing or fabrication plants *ternational Safeguards Nuclear Industry,* edited Mason Willrich, thoroughly amines the problems of pro ing plutonium and uran from theft and diversion.

Most commercial shipping volves loss rates of at least per cent, that is, they sim lose about one percent of w ever they ship. The Ato Energy Commission predi that by the year 2000, a mil kilograms of plutonium will going to and from nuclear po plants every year. Less tha kilograms of plutonium coul fashioned into a bomb t would render a city like Roc ter, MN uninhabitable.

It's easy to read about iss in a book or magazine and cept or dismiss them intelle ally. But if you study an is any issue, long enough you a "gut level" feeling for whet it is right or wrong. The aut suggests that you don't sim accept or dismiss his opini rather, read the materials m tioned in this article and cided for yourself.

Fellowships

For:	In the fields of:	Benefits include:
Masters, Engineer and Doctoral Degrees	Electrical, Aerospace and Mechanical Engineering, Computer Science, Physics and Mathematics	Educational stipend, dependent allowance, all academic expenses, professional salary, employee benefits and travel allowance. Value of these ranges from approximately $8,500 to $13,000 annually.

Be one of the more than a hundred students to win this outstanding opportunity. You will study at a nearby prominent university through the Hughes Fellowship Program. Work-study and a limited number of full-study plans are offered. You also will gain professional experience with full time summer assignments in Hughes research and development laboratories. You may take advantage of a variety of technical assignments through the Engineering Rotation Program.

Requirements: B.S. degree for Masters Fellowships, M.S. degree for Engineer and Doctoral Fellowships; U.S. citizenship; grade point average of 3.0 or better out of a possible 4.0; selection by Hughes Fellowship Committee.

Hughes is substantially increasing the number of fellowship awards leading to the degree of Engineer.

For additional information, complete and air-mail form to: Hughes Aircraft Company, Scientific Education Office, P.O. Box 90515, Los Angeles, California 90009.

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Name (printed): _____

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City _____ State _____ Zip _____

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fellowship in the field of _____

I have (or expect) a Bachelor's degree in _____ (Field)

by _____ (Mo., Yr.)

from _____ (Institution)

GPA is _____ out of possible _____

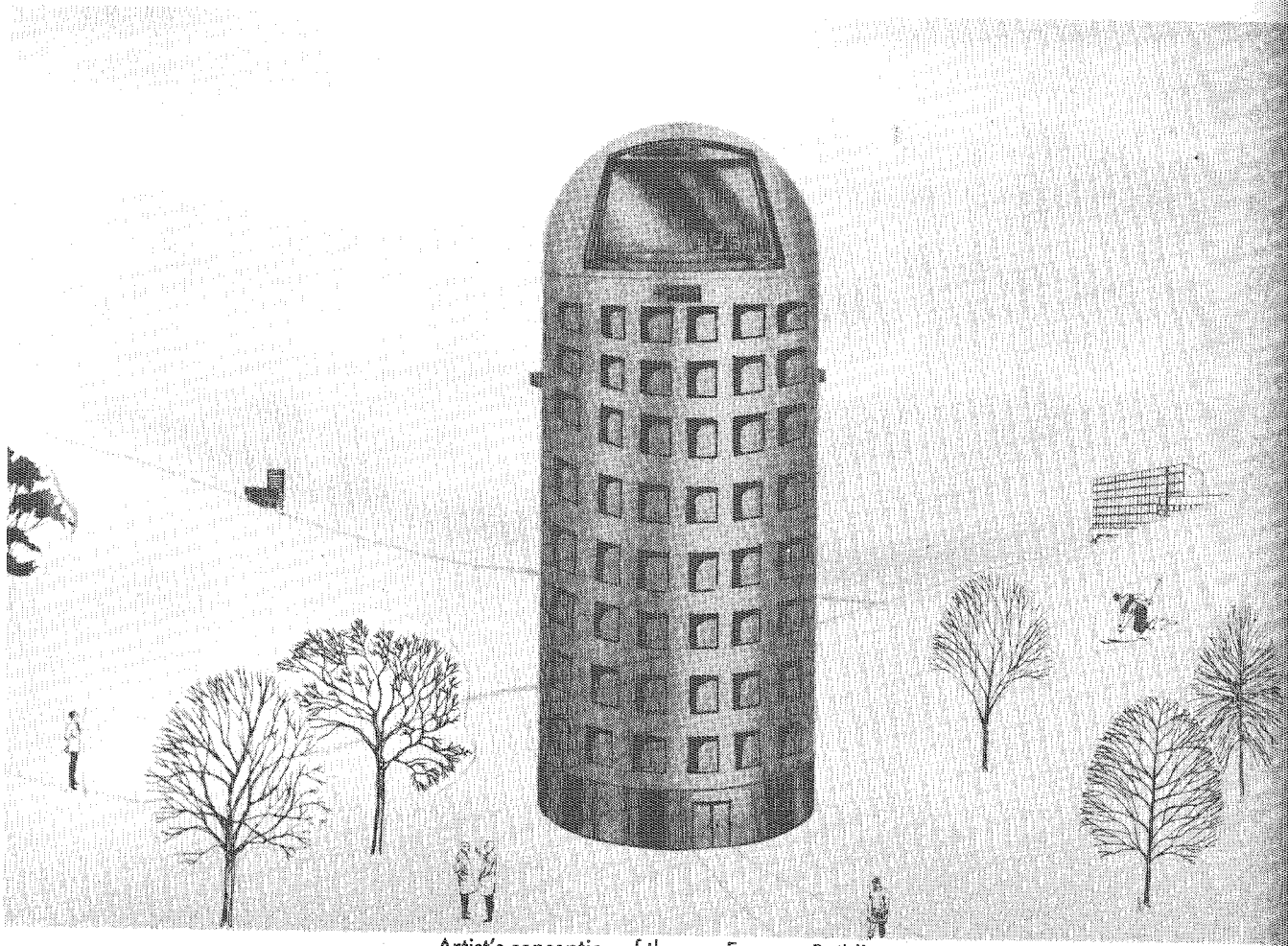
Also have (or expect) Master's degree in _____ (Field)

by _____ (Mo., Yr.)

from _____ (Institution)

GPA is _____ out of possible _____

U.S. CITIZENSHIP IS REQUIRED



Artist's conception of the new Forestry Building.

The TRUE Story Of The Kaufart Forestry Buildin

By Jim Shorts

Last month, the College of Forestry dedicated their newest building, the Kaufart Laboratory of Forest Products and Wood Science. The dedication, of course, was held on Friday, September 13th.

The laboratory, which cost an estimated two million dollars, took nearly 18 years to build. There are a number of reasons why it took such an incredible length of time to plan and construct this building.

The first plans for the building were approved in July, 1956 and the foresters immediately commenced construction. After two years of trying construction crews comprised solely of coolie beavers, the foresters began working on it themselves. The building was complete in October, 1960, but it could not be used. The finished building was inoperable because no one had told the foresters who were in charge of construction that their blueprints were not intended to be the actual size of the building. Thus, the size of the completed building was approximately 4'x5'x7', which was the size of their blueprints.

To plan and supervise further construction, a building committee was formed in 1961. Led by faculty member Everett Green, ass professor of ferns, and Ian Dono, a forestry freshman, the committee, which consisted of two members, began working. They called their group the Add Hock Action Committee for Konstructi (AHACK).

The primary funds for th project came from John Pecunious the tongue depres magnate. The amassing building materials was kick off with a cold lemonade sa which was held on January 1961. By September 5, 19 they had finally gather enough toothpicks, splinte sawdust, peanut shells (for t interior) and glue to begin c struction. The construction w completed by September 7, 19 and the dedication ceremon were scheduled for that ne Friday, the 13th.

At this point a major cri developed over the naming the new building. For yea there had been a running fe

n the College of Forestry over who the building would be named after. It seemed that everybody connected with forestry wanted their name on the building. However, after viewing the completed structure, no one could be found who would accept having the building named in their honor. Even Dr. C. Clearly, the blind professor of wood product safety, refused to have anything to do with the new Forestry Building. Finally, the deadlock seemed resolved when it was decided by a consensus of the original committee to name the building after the deputy vice president of the Institute of Agriculture, Forestry and Home Economics, William Hooey. To avert this, Hooey used executive privledge to decree that the building be named in honor of retired dean of Forestry, Frank H. Kaufart, who was a longtime personal enemy. Since Dr. Kaufart was dean emeritus, and held no position of power or authority, he was powerless to stop the dedication.

Speakers at the dedication ceremony included Board of Regents chairman Elmer L. Answerdung, William Hooey, Kaufart and an original building committee member, student Ian Dono. Dono, who by this time has completed half his junior year, gave the most colorful address of the ceremony. With his pet beaver, named Cuddles, beside him, Dono thanked the College of Forestry for acknowledging his long-time work on the building committee. "I feel pride and joy when I look at that monument to foresters and forestry" he said, regarding the new building. "It represents to me, I. Dono, what being a forester is all about."

CORRECTION

The *Minnesota Daily* is once again guilty of shoddy and inaccurate reporting. In the September 23, 1974 *Campus Notes* feature, the *Daily* reported on the dedication of the new forestry building and quoted Dr. Kaufart totally out of context. Fortunately, reporters from the *Technolog* were on hand to record the actual conversation.

The September 23rd *Daily* reported the following:

Kaufart, commenting on his earlier opposition to the name of the facility, said, "I fought many battles as dean of Forestry, including one over the use of my name on this building," but admitted, "I'm glad I lost this one."

The actual exchange was between Kaufert and a *Technolog* reporter. The conversation is as follows:

Q- Did you oppose the use of your name on the new forestry building?

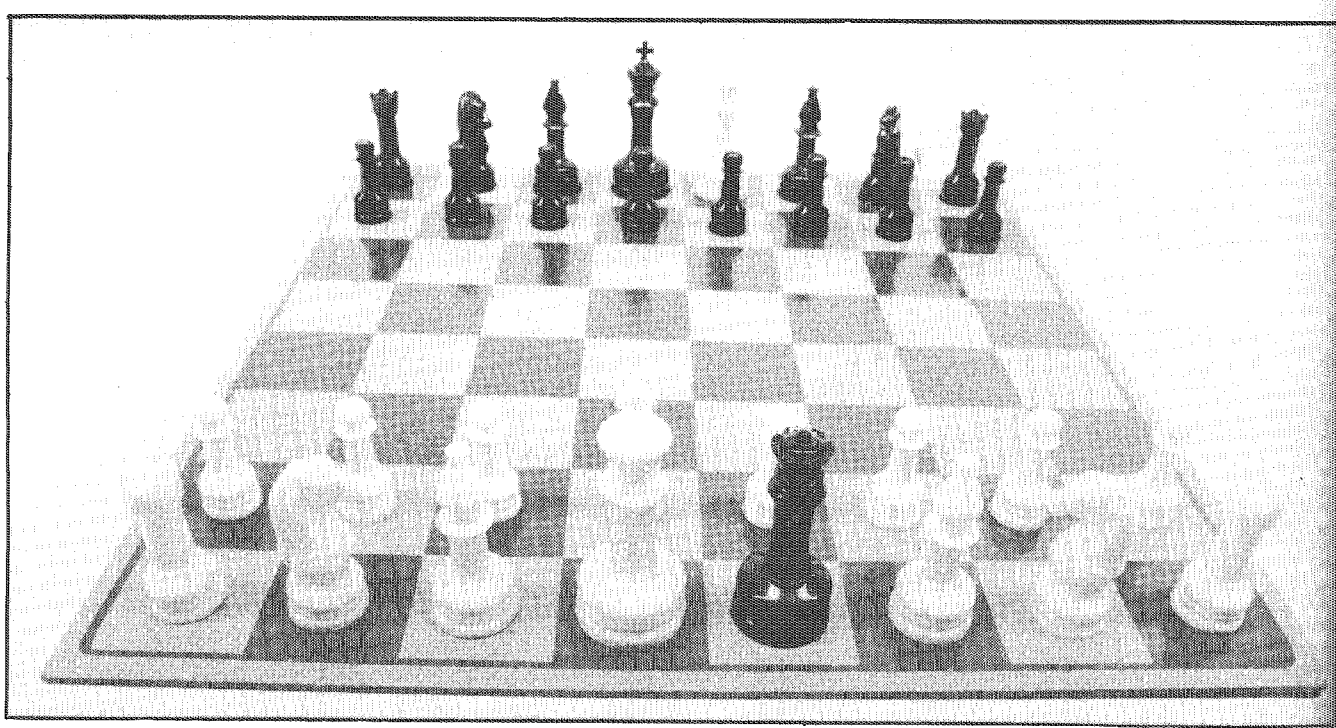
A- Yes. **I fought many battles as dean of Forestry, including one over the use of my name on this building.**

Q- By the way, I heard you just divorced your fifth wife.

A- Yes, and I must admit that **I'm glad I lost this one.**

Dean Kaufart

Ian Dono



I.T. RECRUITMENT: WOMEN and MINORITIE

Minorities and women are seriously underrepresented in the technical professions as a whole and in IT in particular. While industry attempts to find qualified people to meet its Affirmative Action obligations, IT trys to meet that demand, as well as its own moral commitments. The result will be a changing student body, and a broader experience for all IT students.

By Larry Yarosh

While the demands of minority groups and feminists have opened up many high-paying jobs formerly reserved to the white and male, science and engineering are relatively unaffected. Women, who make up half the population and 39% of the labor force, hold only 1.6% of American engineering positions while Blacks, representing over 11% of the population, hold 1.2% of these jobs.* The situation in the physical sciences is little better.

Large employers, faced with Affirmative Action requirements, are attempting to change this picture. But they are finding a shortage of qualified women and minority graduates to fill their job openings. A combination of social pressure, high entrance requirements and the preparation required in science and mathematics has kept these groups out of the technical schools, and thus out of the newly available jobs.

IT enrollment of women and minority groups lags far behind other colleges. Officials were able to find only 15 students from minority groups enrolled last year — about ½% of the student body. Female enrollment numbered 239 or 7% of all students. In order to make the student body more representative without lowering standards, IT has undertaken a whole series of programs to recruit and retain women and minority students. As a result, some of the faces in this year's entering class are different, but only superficially so.

"Peer teachers" in the classroom: High school students in disadvantaged areas are seldom encouraged to take electives in math and science, and usually graduate without the background necessary to enter The Peer Teaching progr headed by Aerospace Engin ing professor Jack Moran tempts to improve instructio inner city schools and to courage more students to t math and science courses.

"If you visit a physics clas one of these schools", Mo says, "you don't find any there." In the Peer Teach program, high school stud are trained to work with regular teacher in various school courses. The prog provides more attention help for the students takin course, and gives the teachers a greater interes the subject being taught.

In addition, the peer teac set an example. "Peer teac is a prestige job", Moran "Other students look up to and gain an interest in and science." The peer teac he emphasizes, are not teachers' aides. "The only you can tell them apart says, "is by how old they ar

The operation begins w nine week course at the Un sity during Spring quarte which college volunteers

regular high school teachers are trained to work with the peer teachers. Then, in a five week summer program, the volunteers and regular teachers train the peer teachers for the role they will perform.

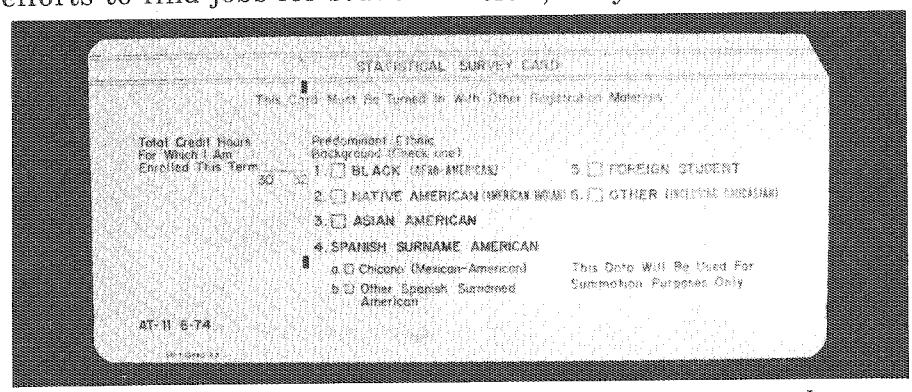
In four years, the program has grown to encompass 100 peer teachers in 15 schools, all in Minneapolis and St. Paul.

Math and science on the job: While the Peer Teaching program is academically oriented, efforts are made to interest students in engineering as a career. To this end, Moran arranges for engineers, scientists and architects to meet with instructors and peer teachers over the summer to write up real life technical problems for presentation in the classroom. High school students thus gain familiarity with industrial problems and the way in which they are solved.

One problem presented to a biology class concerned the levels of Vitamin C in apple cider, a problem already investigated by General Mills' laboratories. Students tested the levels of Vitamin C in apple cider before and after quick-freezing to see if the freezing lowered the vitamin levels below those required by the government.

Merit scholarships for minorities only: The most controversial of Moran's programs is a series of scholarships sponsored by 3M Co. and open only to minorities on the basis of merit, without consideration of financial need. Moran justifies the granting of scarce scholarship money to relatively wealthy students by pointing to the competition from private colleges. Schools such as Macalester College offer scholarships to the best qualified minority students, leaving those with lesser qualifications to pay the University of Minnesota tuition. Those left to the University are viewed to have a low scholastic average and a high dropout rate in comparison with the white majority. By attracting bright minority students through a merit based scholarship, Moran hopes to make all minority students more comfortable in IT and better accepted by other students.

Other IT projects involve contacts with General College to encourage the transfer of GC minority students into IT and efforts to find jobs for students who could not otherwise remain in school. A self-paced freshman calculus course being offered with the aid of an industrial grant will help students with poor mathematics backgrounds cope with calculus.


STATISTICAL SURVEY CARD

This Card Must Be Turned In With Other Registration Materials

Total Credit Hours For Which I Am Enrolled This Term: 30

Predominant Ethnic Background (Check one)

1. ☐ BLACK (Afro-American)
2. ☐ NATIVE AMERICAN (American Indian) *
3. ☐ ASIAN AMERICAN
4. SPANISH SURNAME AMERICAN
   a. ☐ Chicano (Mexican-American)
   b. ☐ Other Spanish Surnamed American
5. ☐ FOREIGN STUDENT
6. ☐ OTHER (Caucasian)

This Data Will Be Used For Summation Purposes Only

AT-11 6-74

Lady engineers: Only a few years ago, social pressures and the "nuts and bolts" image of engineering combined to make IT coeds as hard to find as a Nobel prize winner in Forestry. Women are now entering IT in increasing numbers and the administration is trying to encourage more.

Among IT's most successful programs to recruit women students has been an annual one day seminar to bring high school girls to campus. Last year's program, entitled "Technically speaking — should you?" attracted 120 prospective students to talk to school officials, IT coeds and practicing female engineers.

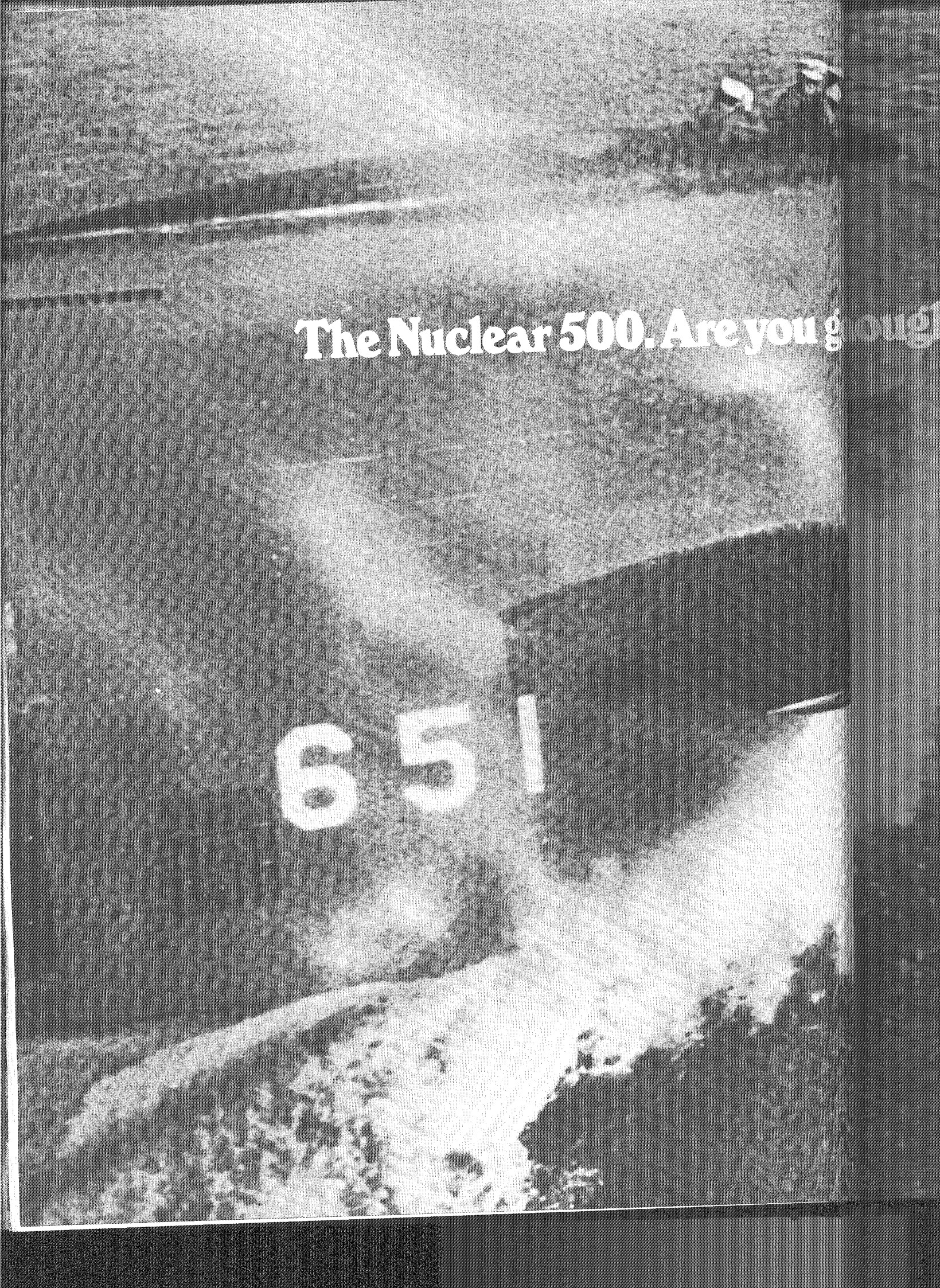
Other programs have sent IT women to visit Minnesota high schools, talking to students and counselors and appearing at school career nights. "Some high school principals were leery" of the female emissaries at first, according to assistant dean Paul Cartwright. But the coeds related well to their high school audiences, and the feedback from their visits has been favorable, he added.

Merit scholarships were offered last year to women only in an attempt to attract superior women to IT. Because of concern that the scholarships constitute reverse discrimination, they will be offered this year to both women and men.

The new coeds, besides reliving the army camp atmosphere of IT, have made a disproportionate contribution to its organizational life. A Society of Women Engineers chapter has been in existence since 1973. Women have served as editor of the *Technolog* and as IT Board president. Three of this year's six Plumb Bob members are women. "They are becoming part of the college", observes placement director Leroy Ponto, "There's no doubt about it."

The number of women and minority students in IT is greater than last year, but not nearly enough to achieve a cross section of Minnesota's population. The number of minority students is thought to have doubled to 30, and the number of women has reached 300. "IT has not done as much as other colleges", admits Moran, "but we are trying to catch up."

*American Indians represent .55% of the engineering profession as opposed to .39% of the US population, a large overrepresentation. Chicano engineers number 20,000 or 1.6% of the profession. Chicanos constitute 4.4% of the population.


The Nuclear 500. Are you g
651

I g[illegible]gh to be one of them?

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a day in the life of an I.T. FRESHMAN

By Jeremy Anderson

Al Gillis sat himself down in the third to the last row of seats in 113 Appleby Hall. He couldn't really figure out why his first quarter calculus course was being held in the Pharmacy building, but when you first start out at the University, you leave certain matters to the Powers That Be and take what They give you.

A short, bald-headed man walked into the room and mounted the rostrum.

"Hello class, I am professor von Furchtbar, your Analysis One instructor." The man had a rather pronounced German accent. "This room will be holding calculus lectures for sections 33, 34 and 35. Recitation sections will be held elsewhere."

Al looked frantically at his reserved-course card. In computer-blue ink, stamped at the top, the card plainly showed that Al was in section 36. Al raised his hand.

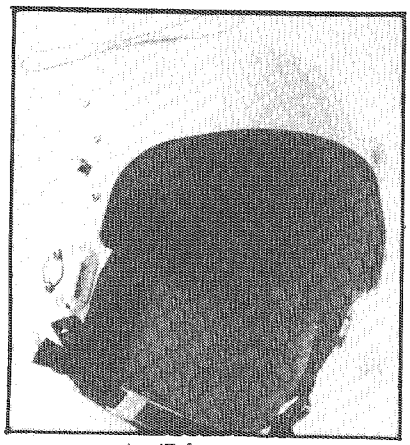
"Uh, Dr. von Furchtbar, what about section 36?"

Dr. Furchtbar looked closely at Al, which was quite difficult since the room was a good 300 feet long.

"Well you know, I chust made up these numbers. These sections are chust numbers, and numbers mean nothing to me." Al looked to the fellow sitting next to him. They started laughing. The whole room began to laugh. Dr. von Furchtbar didn't quite understand what it was all about.

"I suppose section 36 is here also. I don't know, however. I'll chust put it down though." Von Furchtbar wrote "36?" on the blackboard.

"Now ve are chust going to rush through the first chapter of the text, which you should all have committed to memory already anyway," said von Furcthbar. "You all know —though it is seldom covered in most high school algebra courses — about the Principle of Mathematical Induction, so ve vil not discuss that here.



An IT freshman.

"You should also know that you do not always have to write an equals sign between things. This is because things are not always equal!" Von Furchtbar got quite a charge out of this and laughed for five minutes before he could regain his composure. "In such a case ve have vot is known as an inequality. Sometimes things are not only equal but also not only inequal, and ve write this as 'greater or equals than' or 'less than or equals than.'

"Does everybody follow me? Good." Half the class shook their respective heads "no" at this last comment. "Let me write down the homevork then. Can everybody see the side blackboard?" For Al's side of the room, it was utterly impossible to see Dr. von Furchtbar from where he stood, let alone perceive that there was indeed a blackboard there. Al hollere "no," and a young coed groan in the seat in front of Al." Vel vill chust write down t homevork here then." Von Fu chtbar began writing on the visible side board. "Do chapt one, sections one, two and thr problems one through forty each section, and then do the selected problems." Dr. v Furchtbar didn't call out t selected problems; when finished writing, he returned the lectern.

"Now you are probably vo dering about the examinatio I don't know vhen they vill but I do know that ve vill having three or four hour-lo examinations, and ve vill having a final. Vhen the s labus is ready, ve vill be list the times of the examinati there. Also, recitation sectio vill be held; before each exa ve vill be having a spec night-time tutorial held in t basement of the Mortuary S ence building. Are there a questions? I can't see vitho my glasses so don't raise yo hands. Chust come up h vhen class is over.

"Now before I forget, h many here have h trigonometry?" Al and ten ot people raised their han "Good, I'm glad you have had it, because vithout it y vill be flunking this cour Now, since there are no qu tions, class is dismissed."

Al staggered out of the ro waiting by the door until room had emptied sufficientl allow him to talk with the p fessor. As he stood by the d Al lit a cigarette. A fairly g looking young blonde wom came up to him to ask him i

had gotten the homework assignment.

"No I didn't. Did you?" Al asked.

"Gee no. I'm too stoned to believe any of this anyway."

"Far out," Al said as cooly as he could.

"Really," the woman said abstractly.

Just then, Al's friend Reed staggered out of the room.

"I got the assignment. Copy it down quick, I've got to go across to the West Bank for my Poli Sci class." Reed turned to the woman and said. "Hi, my name's Reed. Who're you?"

"I'm stoned," she said abstractly.

"Heavy," said Reed.

"What Poli Sci course are you taking? I'm taking Diplomatic South American Agriculture," she said.

"You mean 'Diplomatic Implications of South American Agriculture'? I'm taking that course."

"Really."

Al finished copying down the assignment. He looked up to see that Reed and the Stoned Blonde were gone.

"Figures," said Al under his breath.

The next day—Tuesday of the first week of classes—Al went to room 113 Appleby again. His calculus recitation was scheduled to meet there.

Al sat down and waited for the teaching assistant to show up. After five minutes had gone by, he noticed that everyone else was fidgeting. Al began to tap his pencil. After ten more minutes of waiting, a few people left the room.

After a few more minutes, one fellow, who had left, came back into the room out of breath.

"Listen everybody," the fellow said, "the Math office just told me that this course doesn't exist. There's some mistake someplace. If you want to change to another section, you're supposed to see Dr. Kant in the math office."

About half of the class left immediately, and the other half of the class followed the guy over to the Math office in Vincent Hall.

Al ran up to the fellow and asked him what could be done about getting into another section.

"I don't know about that. But I'm a grad student, and I can raise just as much hell as they can dish out."

Being a grad student must be like being a god, Al thought.

As they marched up the steps to Vincent Hall, Al thought that the whole thing was getting to be really absurd. He had thought that college was supposed to be better organized and more intelligent than high school. Now he was having second thoughts.

The Grad Student opened the door to the Math office and the 12 people, who filed in, crowded the tiny waiting area in front of the secretary's desk.

"We'd like to talk to Dr. Kant," said the Grad student. "We're all members of the nonexistent recitation section of Calculus One."

"Oh dear . . . we were hoping only you would come back . . . I'll try to get Dr. Kant out of his conference."

Another woman walked by the Grad Student, on her way out of the office. The Grad Student said, "Pardon me, but is there anyone besides Dr. Kant who can help us out? We're in a section of Calc One which doesn't exist, according to the Math Department."

The woman put her hand to her mouth. "Elsie?" she asked in a loud quavering voice. She walked back into the interior of the office, hidden from Al's view by a series of pillars.

Suddenly a small, old man with white, flowing hair appeared in the midst of the crowd of secretaries.

"I'm Dr. Kant, and I want you to know that the situation is well in hand. Mr. Wong is your teaching assitant, and he should be at your recitation room."

"Have you told Mr. Wong about this?" asked the Grad Student.

In a complete deadpan, Dr. Kant said, "Yes, he was informed of this matter weeks ago. He is no doubt at your recitation room."

"We waited half-an-hour for him and he didn't show up," one woman from the course shouted.

"Well, all I can say," said Dr. Kant, taking off his glasses, "is come back to your recitation room Thursday. I assure you Mr. Wong will be there." As suddenly as he had appeared, Dr. Kant disappeared back into the bowels of the Math office.

Al looked at the Grad Student. Seemingly in charge of the situation, the Grad Student said, "Why don't we go back and wait for the T.A.?" Most of the people, including Al, decided to head back to the recitation room.

Out on the Mall, though, a Chinese fellow walked by them. The Grad Student asked him if he were Mr. Wong.

"Yes I am."

"Well, we're your class," the Grad Student replied.

"Oh, I'm sorry I missed you. I thought the abbreviation 'AH' stood for Anderson Hall not Appleby Hall. So I went over to West Bank and found that 113 Anderson Hall is a lest loom.

"I'm sorry. Will see you Thu'sday." He nodded and took off down the Mall.

Al walked up to the Grad Student.

"What do you make of this business?" Al asked.

"I've never seen anything this messed up all the while I've been here, and I went here as an undergraduate too."

The Grad Student walked off. Al wondered what it was like, being in Graduate School. Right now, he wasn't really sure what it was like being an undergraduate.

CAREER OPPORTUNITIES

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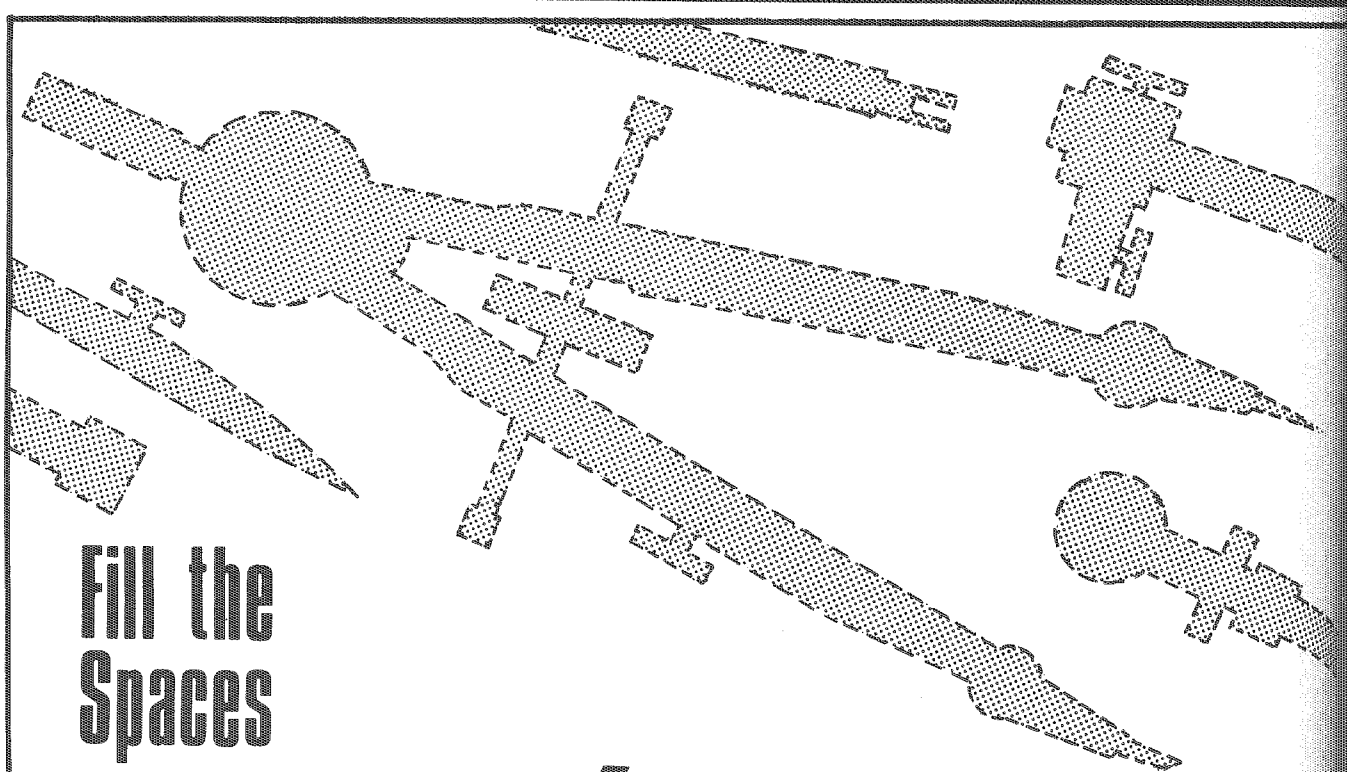
William H. Nord
Personnel Representative
Applied Physics Laboratory
John Hopkins University
8621 Georgia Avenue
Silver Spring, Maryland 20910



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SPERRY UNIVAC

I.T. Student Organizations

IT student organizations are among the strongest and most active on campus. They range from governing boards to IM teams, from Architecture to Chemical Engineering. Their future depends on the commitment of incoming students.

By Roxie Goertz

I.T. students are often accused of apathy and lack of spirit. Although one I.T. student we know had a blank white protest sign to demonstrate his apathy, there are many I.T. students that get together and participate in activities other than school.

Some organizations are in mothballs, waiting for interested students to reorganize them. Other organizations are activily envolved in the I.T. community. Also, there are informally organized groups of I.T. students. As a service to the I.T. community, the *Technolog* has compiled a list of all formally organized I.T. groups. The following list is divided into Governing Bodies, Professional Residental Fraternities, Professional Fraternities, Professional Societies, and Honorary Groups. Most organizations welcome new members who want to become involved. Other organizations you must be invited or elected to.

GOVERNING BODIES

•Twin Cities Student Assembly and University Senate are the student governing bodies for the entire University. The Institute of Technology has 4 representatives who are elected in the Spring of each year. Notification of elections appear in the *Daily*. Any fulltime I.T. student may run.

•I.T. Board — A seedy little office in 230 TNCE houses the I.T. Board. The board is officially described as "the voice of the I.T. students to the I.T. administration and to the the campus community." I.T. Board members hope that it is much more than that.

The I.T. Board consists of 25 I.T. students; one representative from each department; two from each class, freshman thru graduate school; and the four I.T. senators of TCSA.

Board members are elected in May, but there is a variety of related projects and committees that need volunteers. Some projects starting this year are described below.

Committee on Committees - This bureaucratic sounding name is an essential part of ITB. It serves to place students on important organizations and committees. For example, there are now over 200 openings for student volunteers on all-university committees.

Faculty Evaluation - This year the board will probably have a hand in the red-hot issue of faculty evaluations. Although the Board has no official powers in this area, the I.T. administration will most likely seek student recommendations of some kind.

Professional Engineers Student Chapter - The Minnesota Society of Professional Engineers (MSPE) has already contacted the ITB this year. The MSPE would like to see [illegible] MSPE student chapter revi[illegible] since it has been defunct [illegible] several years. Whether or [illegible] this can be done depends on [illegible] initiative of the I.T. board [illegible] the potential members.

E-Week - I.T. Board also i[illegible] sponsible for helping Plumb[illegible] with E-Week activities. [illegible] year, E-Week fell on it's [illegible] due to poor planning as [illegible] scribed in the famous "Tur[illegible] editorial written by Bob P[illegible] in the April '74 *Technolog*. [illegible] has promised to help [illegible] E-Week going this [illegible]

•Technolog Board - Eight [illegible] students are selected to act [illegible] publisher and Board of D[illegible] tors to the editorial staff o[illegible] Minnesota Technolog. [illegible] freshman position is open [illegible] year and other positions wi[illegible] elected this spring.

PROFESSIONAL RESIDEN[illegible] FRATERNITIES

•Alpha Chi Sigma - is a nat[illegible] fraternity for any mal[illegible] female in the Chemical [illegible] gineering field. Members [illegible] one another scholastically [illegible] play on IM sport teams. [illegible] house is located at 613 SE [illegible] Street.

•Alpha Rho Chi helps [illegible] dents find friends as we[illegible] scholatic help in the are[illegible] Architecture and related f[illegible] This is a national frate[illegible] open to interested male[illegible] females. The residence [illegible] cated at 605 SE On[illegible]

•Kappa Eta Kappa is a nat[illegible] fraternity for males and fe[illegible] in Electrical Engineerin[illegible] related fields. Their reside[illegible] located at 330 11th Av[illegible]

•Theta Tau is a national f[illegible] nity for all I.T. males th[illegible]

interested in "friendships and social activities" as well as scholastic help. The fraternity is involved in many outside activities including E-Week, Campus Carni, and IM sports. The house is located at 515 10th Ave S.

•**Triangle** is open to all I.T. males and is a social and academic fraternity. Their outside activities include E-Week, Campus Carni and IM sports. They are located at 521 12th Ave SE.

PROFESSIONAL FRATERNITIES

There are 6 I.T. honoraries, Chi Epsilon for Civil Engineering, Eta Kappa Nu for Electrical Engineering, Pi Tau Sigma for Mechanical Engineering, Sigma Gamma Tau for Aerospace Engineering, Tau Beta Pi for all engineering and Plumb Bob.

Tau Beta Pi has been activily involved by doing volunteer work in the Student Information Center. Also, Plumb Bob always has been responsible for Field Day activities. Their members are chosen secretly with academic excellance and leadership as criteria for selection. Members names are revealed on Field Day.

PROFESSIONAL SOCIETIES

The University has student branches of the American Institute of Aeronautics and Astronautics, the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical and Electronic Engineers, the American Institute of Mining, Metallurgical and Petroleum Engineers, the American Institute of Industrial Engineers, and the American Institute of Chemical Engineers. The purposes of all of these societies are to further interest in their respective fields. Information on membership can be found through the various department offices.

•**Society of Women Engineers** was recently chartered. All I.T. women and women in the pure sciences can join the efforts of SWE to obtain benefits for I.T. women. They presently have a women's lounge and hold periodic meetings.

PUBLICATIONS

•**Technolog** is the magazine that you are now holding in your hand. It has been student produced and written since 1920. It offers I.T. students a chance to practice communicating, which is extremely important in the modern day world.

Articles are first researched and written by I.T. students. Other students get a chance to do editing, photography and typesetting. All production work up to the platemaking stage is done in Room 2 MechE.

Except for the *Minnesota Daily*, no other student publication has been so successful in having a profound influence.

Students interested in writing, photography, and art are always welcomed to try their hand out with publication work.

The above list has been a brief glimpse at the various I.T. organizations students are involved in. The *Technolog* encourages everyone to become involved in at least one organization. Remember that you don't come to the University just to study—you come to a University to be educated as a well rounded individual.

Importance of Extracurriculars

It's wrong to think that your only purpose is to study. Infact, the *Technolog* went to several job placement offices and discovered just how important extracurricular activities are in securing a job. Here are some excerpts from letters written by personnel directors of several large companies:

Ford Motor Company - "We want leadership. Leadership will be judged on evidence of experience and accomplishment in any activities requiring organizational ability to delegate authority to others, and achievement of maximum efficiency without friction. Active participation in extracurricular activities and experience beyond the requirements of a college course will be considered as evidence of that quality of enterprise which is necessary to advancement in industry."

General Electric - "Among the important criteria on which selections are based are the ability to write and express one's self clearly; appearance, personality, physical stamina, a diversity of interest and activities as indicated by extra curricular activities, industry and scholarship."

Kimberly-Clark Corp. - "The applicant should have given evidence of leadership qualities in extracurricular activities and be able to present themselves well in any enviroment. He should be verbally persuasive and enthusiastic."

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A New Improved Freshman Physics Lab

University of Minnesota 7/73
School of Physics and Astronomy E.690

Supplementary Experiment

I. INTRODUCTION

The Physics Department has recently reviewed its undergraduate Physics policy, and this laboratory experiment represents the first flowering of the conferences that were held during the fall quarter of 1973. It should be realized that the adoption of this policy is tentative, and dependent on the realization of the beneficial results expected to accrue. For this reason, the experiment has been limited for the present, to freshman students of demonstrated outstanding ability.

The choice of this particular experiment as a sounding board for the new philosophy of the Department was motivated by two considerations:

a.) The new philosophy per se.

b.) The excess of graduate instructors.

Whether or not these considerations will be adequately dealt with, can in the last analysis only be determined after the experiment has been performed. With its usual perspicacity, the department has tried to foresee all possible contingencies and account for them. Of course the Department ostensibly being only human, there is a small but finite probability of some defect in the experimental method having been overlooked. The theoretical physics group wishes explicitly to state that they are not the experimental physics group, and do not claim responsibility for the experiment's outcome. However, they state, in theory at least, the experiment is completely sound, without flaws of any form.

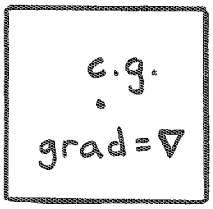

fig. 1

II. INSTRUCTIONS

The experiment is limited to freshman students in the upper one fourth of the class. All students who qualify and wish to take part in this experiment must indicate their desires by submitting a sealed envelope with their name and address to Room 613 Physics not later than_____. From those applying, forty-two percent will be chosen, on the basis of extracurricular activities.

The experiment will take place on _____. The students will be excused from all classes that day. The experiment may be substituted for any one of the regular laboratory sessions. You will be graded on your work but the lowest grade will be a B.

You will present yourself in front of the Main Engineering Building on or before 5:00 a.m. the morning of the experiment. Those of you who will return, will do so at 2:30 a.m. the Sunday after the day of the experiment.

III. THEORY

Basically, the experiment is a verification of all the Newtonian Physics you have learned so far, plus a new relation:

$$E = mc^2$$

Where E = energy in ergs
m = mass in grams
c = 2.9976 $\pm$ .00004210 cm/sec (velocity of light.)
Note: c is a physical constant.

This is the relativistic energy relation and it is derived by means of the theory of special relativity. It can be arrived at by using the Lorentz transformation properly.

By bringing together the critical mass of plutonium, and by appropriate measurements and calculation, the relationship will, it is hoped, be verified.

IV. PROCEDURE

The students will work in groups of three. The experimental apparatus will come in a kit that will be issued just before the experiment. Each group will be issued a graduate student and a critical mass. NO MORE THAN ONE CRITICAL MASS WILL BE ISSUED TO A GROUP. However, if you use up a graduate student, another will be issued.

You will note that each kit contains a black box two meters by one meter. Place your graduate student (abbreviated grad or ▽) in the black box. We have tried to select only plump grads, so to a first approximation the grad completely fills the black box.

Displace the grad in water, and by means of Archimedes principle, calculate his density, ρ . As a control, do the same with one of your partners. Note that in every instance, the grad is denser than the undergrad. This is a basic law.

You will notice two small boxes; each contains one half of a critical mass of plutonium. Do not place these boxes in proximity. This could ruin the experiment, and you will not be issued any more plutonium.

Place the clock and the meter stick in the black box with the grad. You may recognize these as the apparatus used in experiment number 5, Measurement of the Speed of Light with a Clock and a Meter Stick.

Taking your critical mass, weigh it and place it in the black box with the grad. Then, using the lead blocks you will find in your kit, build a Gaussian surface around the grad. Then retire to about 5000 ft. from your experimental site.

Your grad has been instructed, as a part of course Phys 86969--that leads to an especially high degree (Ehd)- to place the two boxes in proximity and record the results in a University of Minnesota Lab Book, obtainable in the Engineering Bookstore, but will be supplied with each kit. You will use this data in your writeup.

V. OBSERVATIONS

This will become self evident.

VI. CALCULATIONS

After a suitable time has elasped, return to the experimental site. Do not be disheartened if there is not anything immediately apparent. Physicists are often faced with discouraging results.

A little consideration will show that although the grad is nowhere in sight, theory predicts that his center of mass is still in the middle of the site. This should be encouraging. Therefore, using this point as the origin in a spherical co-ordinate system, and designating a small volume of the grad as dV we can write:

$$dV = r^2 \sin \phi \, dr \, d\phi \, d\theta$$

Normalize the Grad student (this is probably the most difficult part of the experiment as grads contain a large number of singularities). We then integrate the grad student over all space.

$$\int_{\text{all space}} \int \int \text{grad} \quad r^2 \sin \phi \, dr \, d\theta \, d\phi = 1$$

If this integration is performed properly, you should re-obtain your grad. This is a direct verification of the completeness Theorem.

If some parts are still missing, expand the grad in a Fourier Series and using the mean square deviation criteria, determine which parts are missing. This represents a defect which can be removed only by perturbation theory. A couple of professors will be available to supply the necessary perturbations.

All your data should be obtainable from the grad. Of course you must expect some error, due to the Uncertainty Principle which states that if a random sampling of grad's is taken on any particular question, the answers lie in a gaussian distribution about the correct answer. However, as your grad was part of a moving coordinate system relative to the earth, you should be able to verify the Lorentz space time relationships.

Ask your Grad only intelligent, pertinent questions. Due to the large amounts of energy absorbed by the grad, he was throughout the experiment in a high quantum state, and therefore you will not be able to verify the quantum theory with this lab. You might ask, though strictly off the record, whether he felt predominently like a wave or a particle. This may be significant. Due to the grad's dispersion, a single wavelength cannot be assigned to him. However, he can be represented as a wave packet that spreads with time. He will not radiate intelligence.

The write up will be left to the student's ingenuity.

VII. CONCLUSIONS

When you have finished the experiment, return the apparatus and as much of the grad as remains to the laboratory supply room. The reports should be turned in no later than 24 hours after completion of the experiment.

*

I.T. Opinion

Can You Believe The AEC?

The AEC's massive Rasmussen Report argues that nuclear power plants pose a negligible danger to the public. But nuclear critics aren't so sure. The author, vice president and public information director of the Minnesota Environmental Control Citizens Association (MECCA), takes a skeptical look at the report.

By Russell Hatling

The *Reactor Safety Study* released in August of this year is the AEC's largest attempt yet to establish the safety of nuclear power plants. It is an attempt to put to rest, once and for all, a study that has haunted the AEC since 1957....the Brookhaven National Laboratory Report, *Accidents in Large Nuclear Power Plants*, which postulated 43,000 illnesses, 3400 deaths and $7 billion in property damage from a serious nuclear reactor accident.

The commission made unfounded extravagant claims at the time that such an accident would never occur. The new study concludes that the worst possible reactor accident would kill 2300 people and cause $6 billion in property damage. But it argues that the chances of such an accident occurring are no greater than 1 in 200 million years per reactor.

Now that should be reassuring. The new study, a document fourteen volumes long, took two years to complete and involved 50 man-years of work at a cost of three million dollars. Impressive. So why is the study being flatly challenged by nuclear critics after only two months on the street?

Part of the disbelief is undoubtedly a hangover from experiences critics have had with previous AEC claims for safety. Consider the bald-face admission made in the introduction to the *Reactor Safety Study:*

It is of interest that, at the time of the Brookhaven National Laboratory study, only a few very small military power plants existed and no commercial nuclear power plants were in operation, although some were being designed and constructed. Furthermore, techniques for predicting the likelihood of failure of engineered systems had not been well developed. Clearly, even if the reliability techniques needed for risk assessment had been available, the engineering information needed to draw meaningful conclusions about the probability of accidents in future plants did not exist.

Think for a minute about what the AEC is really telling us: Despite believing what they did about the potential disastrous consequences of a nuclear reactor accident...despite not knowing the probability of such an accident occurring...since 1957, they licensed 50 nuclear reactors to operate.

And now the AEC is saying, and expecting us to believe it: See — we were right all the time — nuclear reactors really are safe.

Bull shit. Little wonder that the credibility of this study, financed and under the day-to-day direction of the AEC (Saul Levine, staff director, and nine other AEC employees) is being challenged. Little wonder that the study will be examined with a fine-tooth comb by lay persons and qualified scientists alike.

It would be the height of presumption to claim to have completely critiqued this voluminous study after only two months — or even to claim the capabilities for making such an analysis. Yet even a cursory reading reveals obvious basic inadequacies in assumptions made by the study.

Assumption 1: The safety system of a nuclear reactor will work as intended. There has never been a test for a complete nuclear plant safety system and probably never can be until a disaster occurs. In model tests, the Emergency Core Cooling System, a vital part of the total safety system, failed time after time.

Assumption 2: 90% of the potentially affected public can be evacuated in case of an accident. The AEC makes this claim while avoiding responsibility for evacuation which it assigns to the utility and local and state officials. The Commission does not even look at final safety procedures, inclu evacuation plans, until the rea has been built and is ready to ate.

Success of evacuation would pend on how much time the po tion had to get out of town. Commission assumes that t would be adequate notice. The mission assumes also, that the u would do the right thing and prompt warning when an emerg arose.

Assumption 3: The study use tual population data rather than jected data for areas in the vicin actual reactor sites. While the is based on the number of rea predicted to exist by 1980 (doubl number now), population den and distribution are assumed main stable.

Assumption 4: The study ass the accuracy of analytic me which are relatively new. In co ing risks of nuclear accidents to of non-nuclear accidents, the value is given to *estimated* nu risks as to *measured* non-nu risks.

The observations noted here be multiplied as qualified sta cians and nuclear experts com examination of the *Reactor S Study*. Interestingly, growing sent among AEC personnel ind that important criticism may be ing from that source. Since pu tion of the study in August th lowing news appeared in the *neapolis Tribune:* [1]

...a leading AEC safety exper nounced that he was quitting job with the Commission "in o to be free to tell the American ple about the potentially dan ous conditions in the nation's lear power plants." Car Hocevar, the author of one o AEC's basic nuclear power-p safety analysis methods, sa his letter of resignation to c man Dixie Lee Ray that "in of the soothing reassurances the AEC gives to the uninfor misled public, unresolved q tions about nuclear power sa are so grave that the U States should consider a com halt to nuclear power plant struction while we see if serious questions can, some be resolved." ...one of se safety research experts who resigned recently from

Commission's Idaho Safety Research Center, said that he planned to ...inform the public that the Commission was using "wholly unacceptable" methods to judge the dangers of reactors.

Many believe the *Reactor Safety Study* may be a desperate act to sustain growth of a nuclear power industry faced with growing public awareness of extremely serious unsolved problems...accumulating wastes, waste management problems, potential sabotage, diversion of fissionable materials, escalation of world-wide nuclear weapons capabilities, increasing levels of the earth's radiation.

These drawbacks are serious. Nobody has said it better than Dr. Hannes Alvin, Nobel Laureate in physics, who wrote in 1972:[2]

"Fission energy is safe only if a number of critical devices work as they should, if a number of people in key positions follow all their instructions, if there is no sabotage, ...and no revolution or war — even a conventional one — takes place in these regions...no acts of God can be permitted."

Can you believe what the AEC *Reactor Safety Study* says about reactor safety? Are reactors really safe? Many, including this writer, believe it's time to call an immediate halt to further development of nuclear power.

...will close 21 reactors for checks," *Minneapolis Tribune* September 22, 1974.

...nnes Alvin, *Bulletin of the Atomic Scientists* May, 1972.

I.T. Things

Energy from the wind: The first major contract has been let in a federal program to construct a wind turbine generator to produce electric power. The device, to be built under a joint NASA/NSF program, will have a two bladed rotor 125 feet in length mounted along with a generator and transmission equipment at the top of a 100 foot tower.

The transmission, which connects the rotor to the generator with a horizontal shaft, turns the shaft 45 times faster than the speed of the rotor to drive the generator at 1800 rpm in an 18 mph wind. At that speed, the generator will produce 100 kilowatts of electricity. A special device will change the pitch of the blades as the wind changes to keep the speed of rotation constant.

If wind turbine generated electricity proves both practical and economically successful, its proponents predict that 5 to 10 percent of US electrical power may eventually be produced on large windmill farms.

Solar energy bills advance: Both the Senate and the House of Representatives have passed bills supporting research on solar energy. The bills would set up an interagency board to administer the research, to eventually be absorbed by an Energy Research and Development Administration.

The senate bill would appropriate $1 billion over five years for the research. Sen. Humphrey said that the proposed budget was "more than 10 times the total of all federally supported solar energy activity in the last five years." The House version authorizes $2 million in NSF funds for fiscal 1975.

The Atomic Energy Commission's budget for fiscal 1975 is $3.06 billion.

It is expected that solar energy could contribute u 30% of the nation's energ quirements after the year 2

Hang the Duluth Gabbro in bedroom: US Geological su maps of Minnesota are no ailable from the Minn Geological survey. Maps o entire state or of southeas southwestern or central n ern Minnesota are availab scales of 1:250,000; 1:62,50 1:24,000.

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products ☐ processes ☐ production methods ☐

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Keeping the factory running ☐

Research . . .

fundamental ☐ not so fundamental ☐

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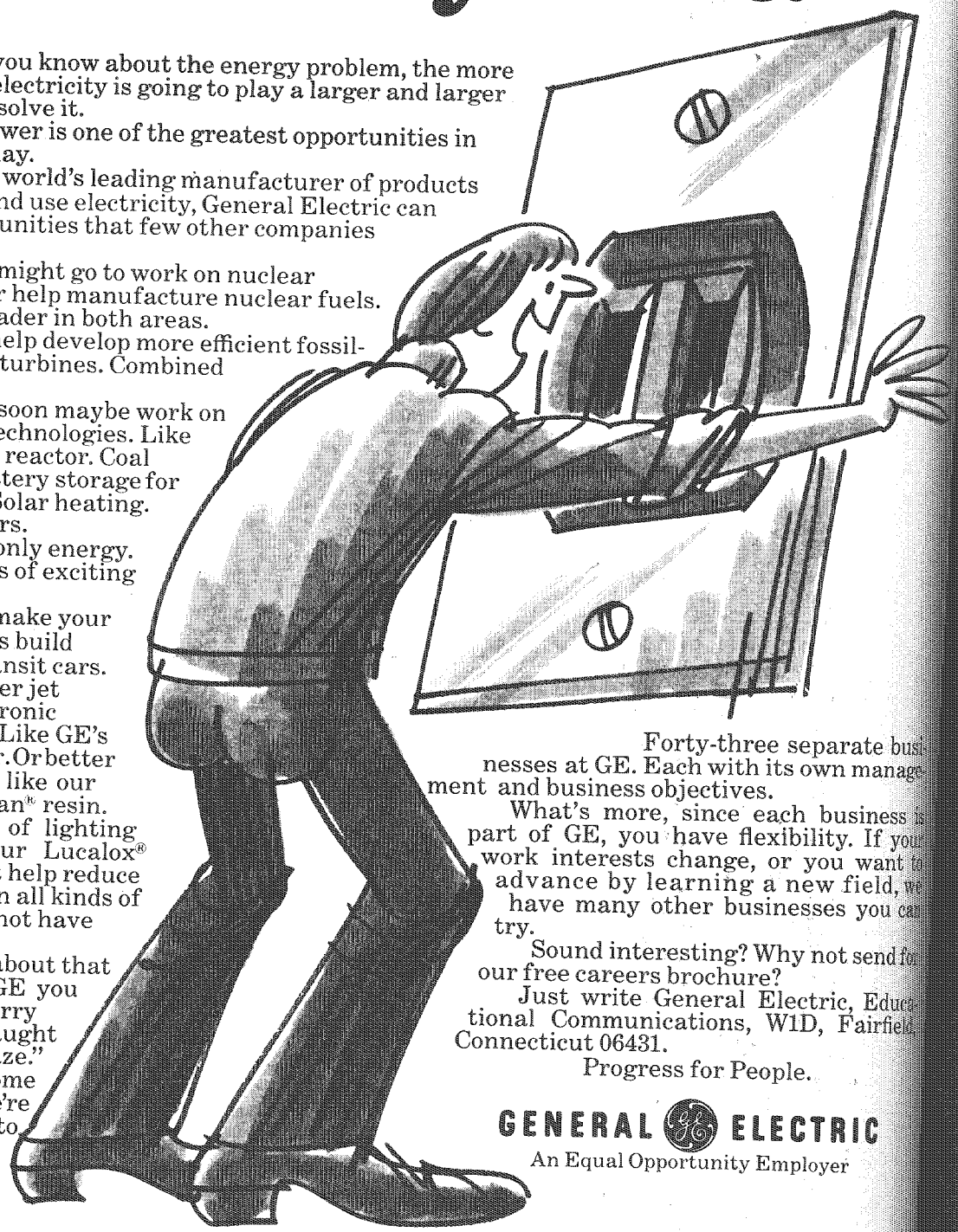

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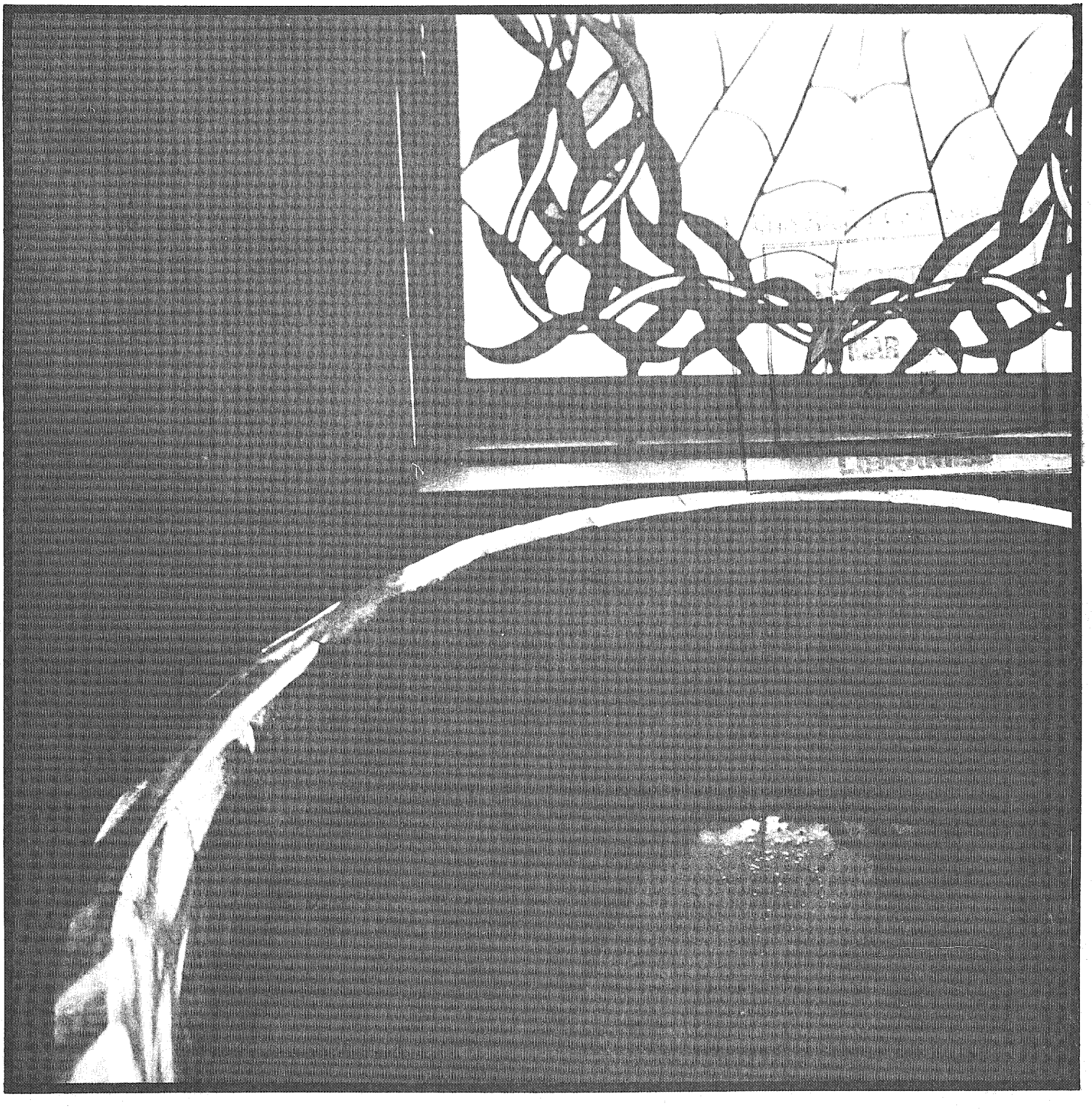

Ray Jaeger wants to make light of phone calls...

by sending them through tiny glass fibers on beams of light pulses. To this end, Bell Labs ceramic scientist Ray Jaeger has helped design a new system to make such fibers — using a powerful carbon dioxide laser.

In the future, one hair-thin fiber might carry several phone calls within big cities or as many as 4000 long-distance calls. But many problems must still be solved. Ray tackled one of them — the problem of today's glass fibers, which contain impurities that absorb and weaken light beams. One impurity source is the conventional heaters used to melt glass rods that are drawn into fibers.

Ray had to find a "clean" heat source that also would be precisely controllable, to assure uniform diameter throughout a mile-long fiber. Using his broad knowledge of ceramic materials — he's a 1967 ceramic science Ph.D. from Rutgers — Ray studied many heat sources. But he finally explored a new approach: melt the glass rod with a carbon dioxide laser.

To make fibers, Ray had to devise a way of focusing the laser beam uniformly around the rod's circumference. He solved this major problem with a rotating lens and reflectors, to form a doughnut of radiation around the rod. Now Western Electric engineers are studying variations of such a laser system to develop the most practical manufacturing procedure.

To make optical communications useful, other Bell Labs scientists are working on ways of splicing glass fibers. And on better, cheaper, longer-lasting light sources and efficient ways of getting calls on and off light beams.

Although today's communications systems are more than adequate, someday there will be a need for the added versatility and capacity of optical systems. And the Bell System will be ready because of Ray and others like him.

Bell Labs

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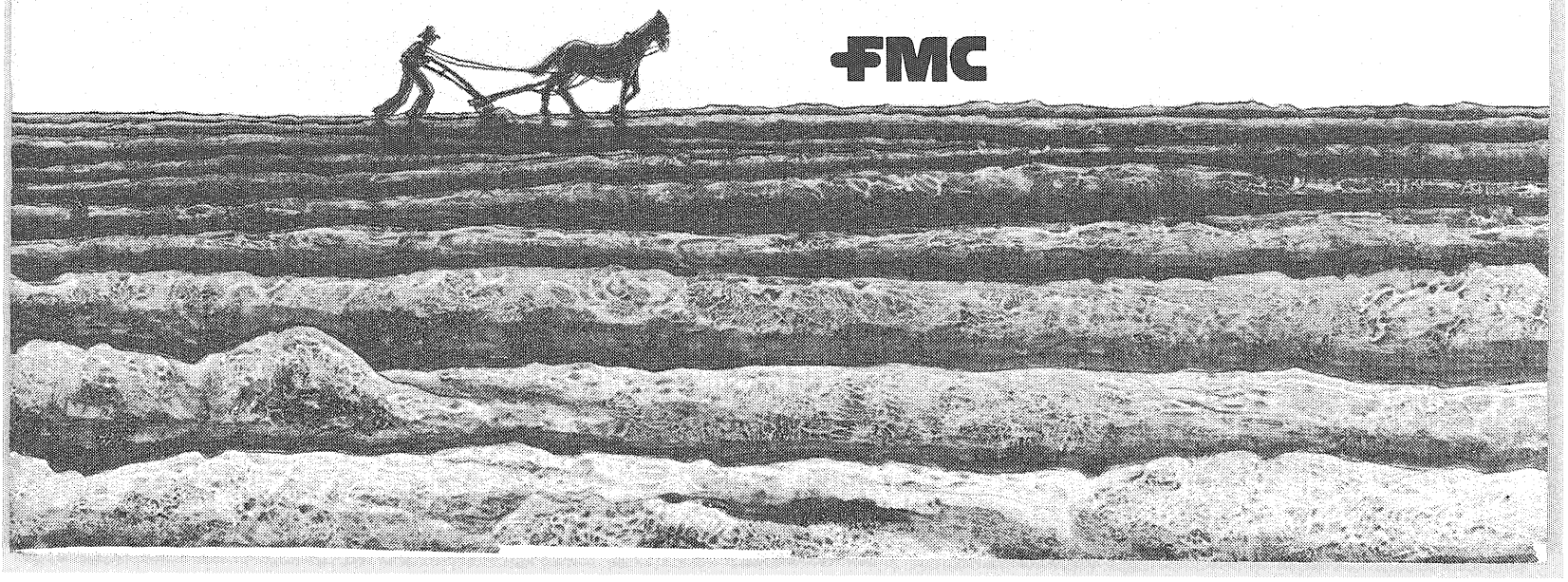

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Ronald C. Haglind, B.S., 1968, M.S., 1973, Mechanical Engineering, University of Minnesota. Presently, supervisor, project analysis section, Mechanical Analytical Division.

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Technolog editorial pages

National Awards

The Engineering College Magazines Associated, of which the *Technolog* is a member, has released its 1973 national awards. The *Technolog,* competing with almost fifty other student magazines, earned awards in eight of the ten categories in which awards were made. They were: *Best Technical Article:* Third place award for "Towards a Hydrogen-Powered Future" by Paul Burtness, October 1973. *Best Non-Technical Article:* Second place award for "Cloning: Developing a Reproduction Line" by John Hollenhorst, January 1973. *First place awards:* Best Layout (single issue): January 1973. Best Layout (all issues). *Third place:* Best Covers (all issues). Best Single Issue. Best All-Round Magazine. *Honorable Mention:* Best Editorials (all issues).

The editor from January through May was Bruce Wright; from October through December, Bob Pirro.

Ag Engineers

This month, for the first time in living memory, the Agricultural Engineers are mentioned in the *Technolog* (see "IT Things").

Isolated as they are on the far-off St. Paul campus, we don't know whether the Ag Engineers are true engineers or a species of forester. Either way, solar power may soon come to the cornfield.

Letters

Sexism in IT

Your article, "Recruiting Women and Minorities", (November 1974) lauded IT for its efforts to increase enrollment among these groups, saying that IT is trying to meet its "moral commitments" and provide industry demand for foot soldiers at the same time. How commendable. And how is IT doing this? By staging recruitment seminars for high school (high school!) girls entitled "Technically speaking—should you?"

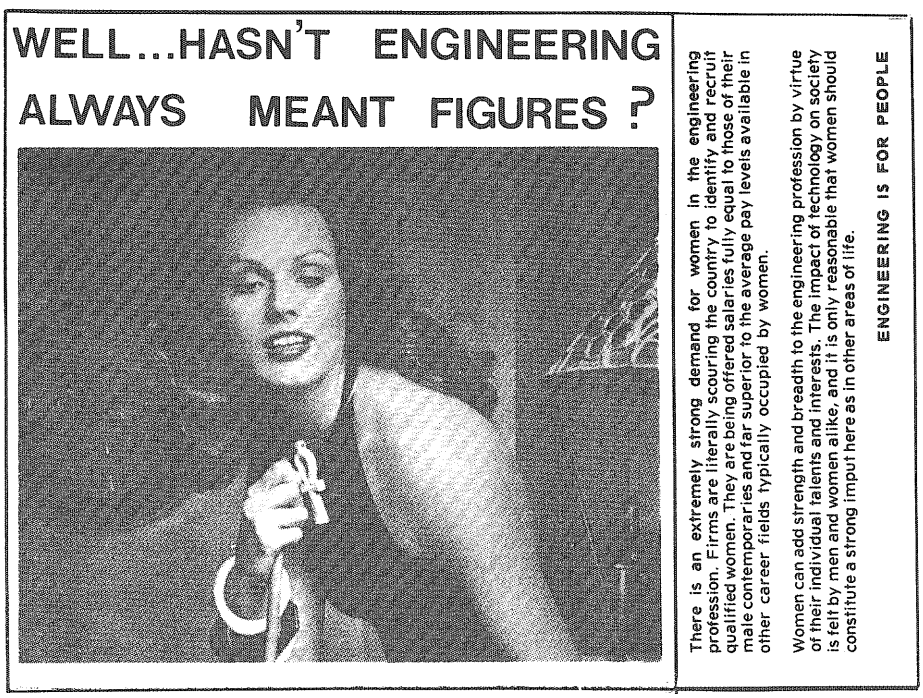
May I suggest that any institution without the sensitivity to see the latent insult behind that gem is never going to attract many women or minorities. The author points to the "social pressures" which have kept women out of the sciences. Well, social pressures don't walk up and announce themselves by name. They are made up of many insidious references —like a title which frames an issue of women and science careers in terms of sex.

Technolog itself shares in IT's lack of perception. Appearing in the same issue was another article, "A Day in the Life of an IT Freshman", which managed to slur two ethnic groups by pointing out their speech mannerisms. Quaint.

The issue also featured a computer print-out representing Male and Female. It should be noticed that Male is a complete figure, less genitalia. Female is a pair of well-rounded breasts. If you must run these clever tributes to computer wizardry, how about adding the missing parts to both figures?

Marianne Yoshida

Below: Recruiting poster designed by Engineering Honors Seminar, Kansas State University.



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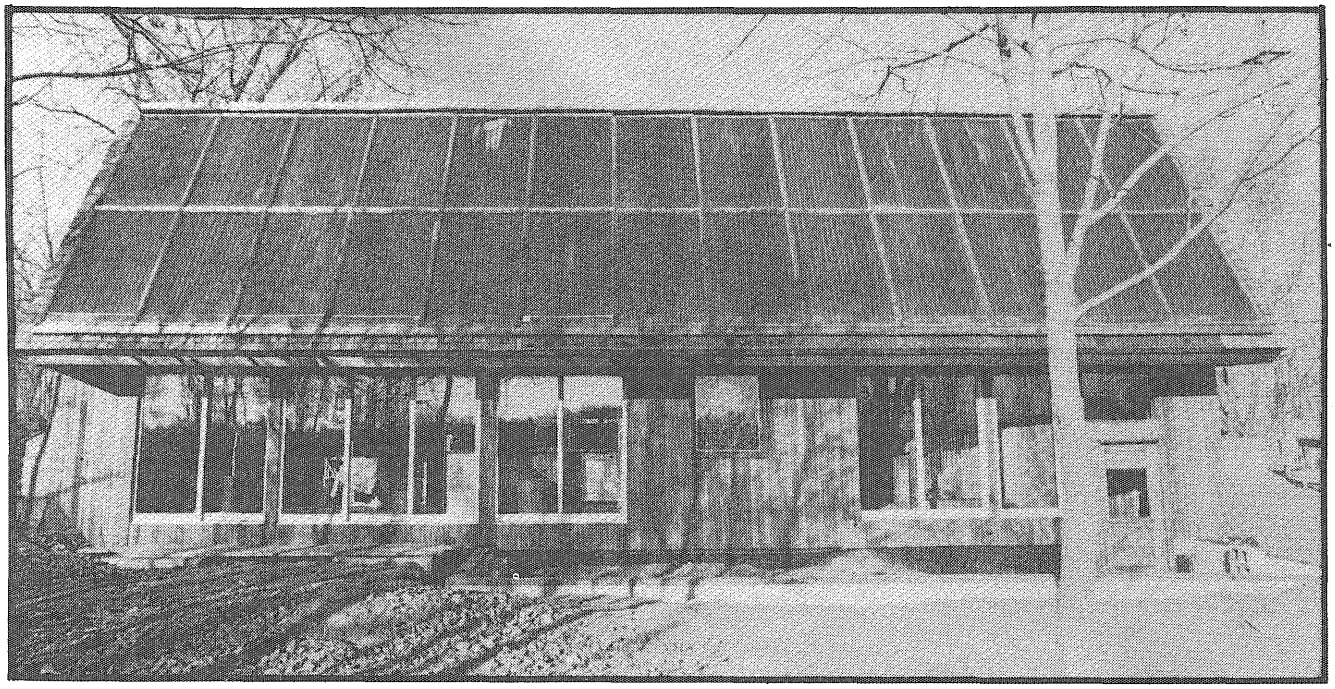
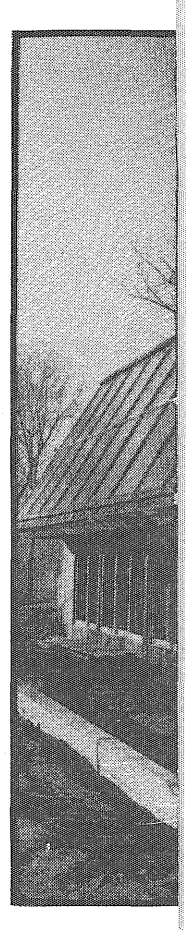




OUROBOROS

The mythical Ouroboros was a creature that fed on its own tail. Project Oroboros, described by The Whole Earth Epilog *as the "best school work we've seen" is an attempt by student architects and mechanical engineers to build a dwelling that recycles its own wastes and takes its energy directly from the sun and wind. In the process, it is testing devices that might someday be part of every Minnesota home.*

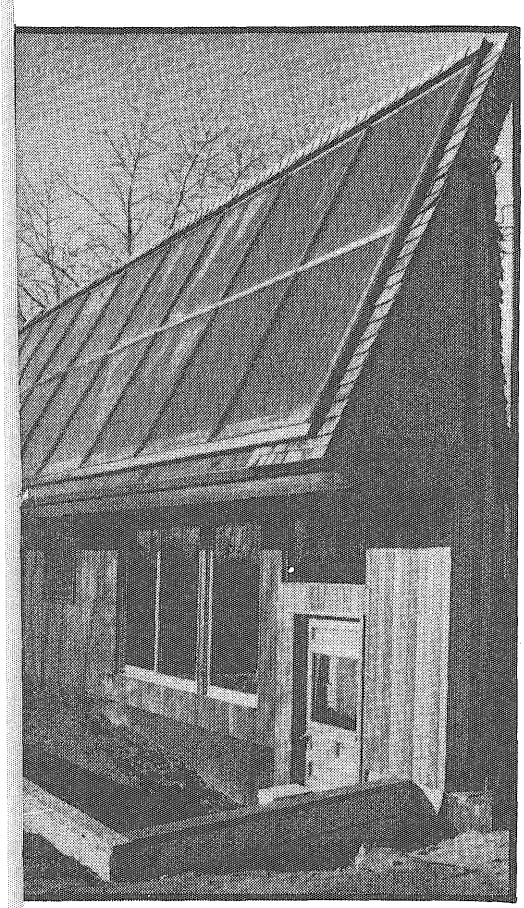
By Bob Pirro

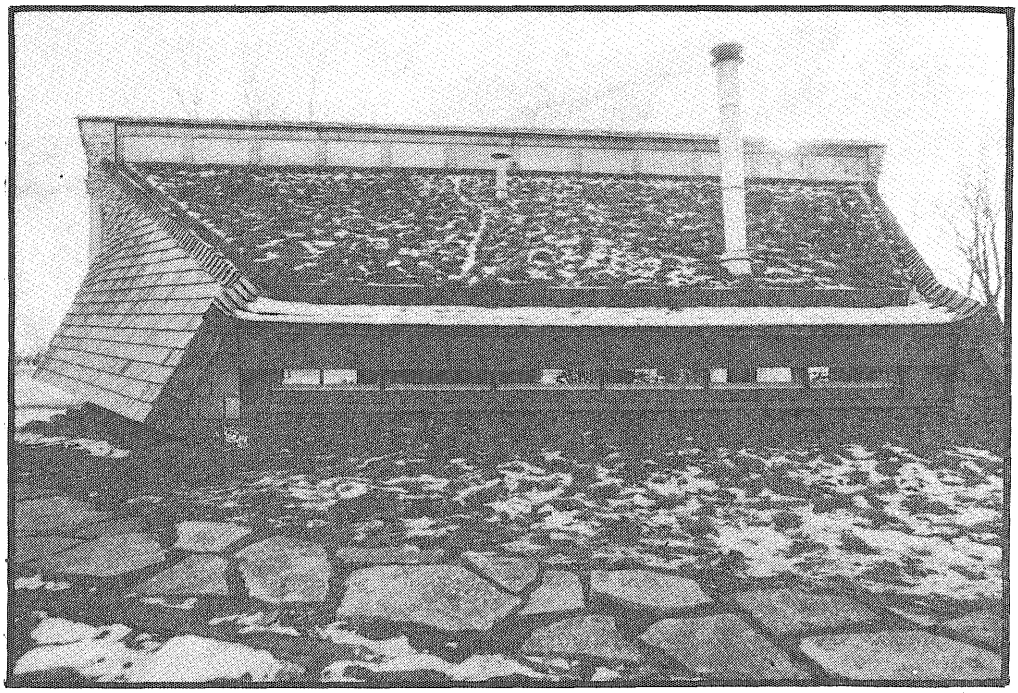
The tail of Ouroboros seems to be the tale of how an on-paper project turned into an actual creature. Whether this animal turns out to be man's best friend or the proverbial white elephant remains to be seen.

Project Ouroboros is the name given to the experimental home recently constructed at the University Research Station at Rosemount. This home grew out of a project assignment given during winter quarter, 1973 to architecture students in an Environmental Design class. The goal of the project was to ultimately design a structure that would stress the incorporation of energy saving and recycling devices. Dennis Holloway, assistant professor of Architecture and instructor in the course, explained that this project "was really an exercise in design, not in construction." While actually constructing a home was not the original intent of the project, it seemed like the natural thing to do after the design was completed. So they did it.

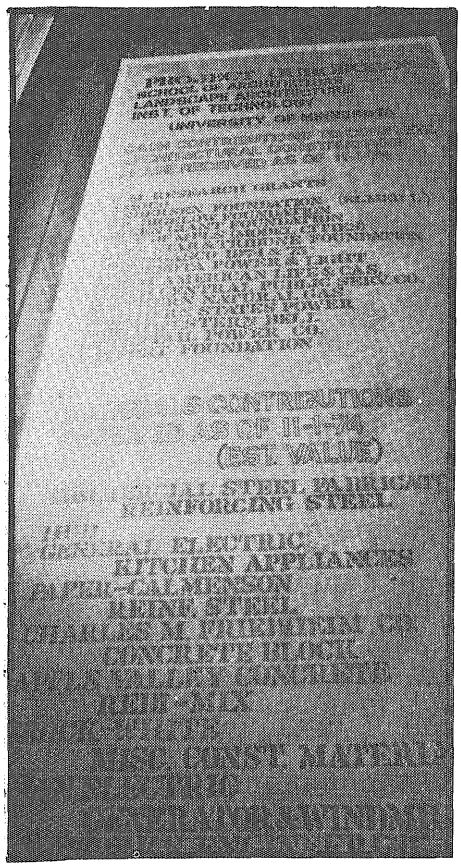
Overall, there were approximately 150 students actively involved in the project. The first step was to split this class into 15 groups of 10 students each, who would perform crude research in one specific energy conserving area. The 15 groups were then each required to produce an actual design of an energy conserving house which emphasized and incorporated the findings of all the research. The final design was a synthesis of two of those design models. This final design was not solely the work of architecture students. Both Architecture faculty members and teaching assistants, as well as students and faculty from the Engineering Design Studio of the Mechanical Engineering department, actively participated in the design.

At first glance the structure itself is hardly impressive. The house is built in the shape of a trapezoid with maximum exposure given towards the south side. The roof facing the southern side





Above left: Exterior view of dwelling showing the Thomason solar collector. Above center: Foundation for future greenhouse. Above right: Insulating sod roof. Left: Winter snow provides further insulation for the roof. Below: Partial list of contributors to the project.



incorporates a solar collector, which is the heart of the house's energy generating system. The roof is built at a 60° angle to the vertical. This angle, plus the southern exposure, insures that the solar collector can gather energy most advantageously. The other walls gradually taper towards a small north-side wall, which helps to reduce heat gain in the summertime and heat loss in the winter.

The 2,000 square foot house incorporates such energy saving features as increased insulation in the walls and windows, a windmill and water and sewage recycling. Perhaps the most intriguing overall aspect of this two level house are the unique roofs.

The southern roof consists mainly of the 700 square foot Thomason flat plate solar collector. The collector is basically a sheet of corrugated, galvanized steel, painted black, which is covered by two sheets of glass. Water is then pumped over the steel sheet. The water absorbs heat, then is drained into storage tanks located in the basement. The tanks are surrounded by crushed igneous rock. An ordinary forced— air system blows air through the heated crushed rock, and the newly heated air is drawn to the rooms upstairs.

The roof on the north side of the house is covered by two layers of sod. This is actually a very old design, originating hundreds of years ago in the Scandanavian countries. In the old country, they first laid down a layer of birch bark over the framework, then placed the two layers of sod over

the bark. The first sod layer was set with the grass pointing down and the roots facing up, with the upper layer being laid with the roots pointing downward. This was done so that the roots of the top layer had something of substance to attach themselves to.

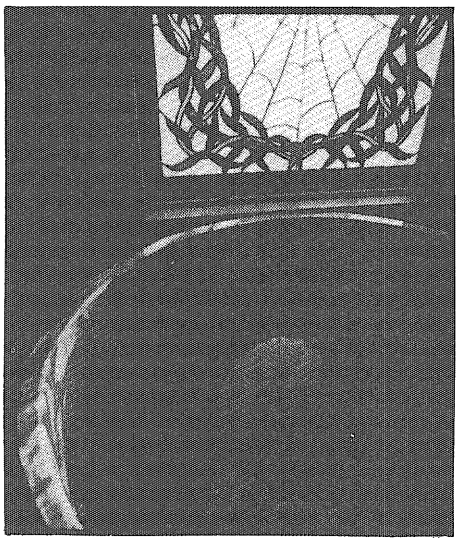
In the experimental home, it was necessary to substitute black felt paper for the birch bark, but that has been the only departure from tradition. Winter snowfall will provide even better insulation for the house than sod alone, as snow acts as an additional insulating layer. Snow has always been an excellent source of insulation, due to the dead air space it contains. So a layer of snow insulates in much the same way as layers of blankets or clothing.

Incidently, there is some truth to the rumor that during warm weather a goat will be placed on the roof, to act as a sort of organic grass cutter. It might also be a source of fresh milk. If this comes to pass, the occupants of the house need never worry about fertilizing the sod on their roof. The goat will take good care of that task.

Just about the only drawback to such a roof is its weight. With the collector and sod, it weighs more than twice as much as a conventional roof and this must be accounted for in the construction and design. The load would get even heavier when snow fell on it.

The walls are constructed to contain as much dead air space as possible, to help insulate the house. The north, east and west outside walls, which face the prevailing winter winds, also have four feet of earth stacked up against them. This raises the frost line and helps to keep the basement warm. The windows each ahve two panes of glass, with dead air space between the panes. There are a good number of ground level windows to provide circulation.

The interior of the house is quite plain, but by no means stark or barren. The living and dining areas are separated by movable panels with a kitchen area tucked in a corner. The sleeping quarters are in an upstairs loft. The only visible construction metarial employed, other than glass and rock, is wood. The outside walls as well as the interior wallsceiling and floors are all wood-finished. The only set walls in the interior of the main level are those which surround the bathroom, which is the basis of the water-recycling and waste disposal systems. .



Japanese bath cleanses without soap.

The bathroom has a clivus multrum which is basically a composting toilet. Used quite extensively in Sweden, it employs aerobic bacteria to break down wastes into usable fertilizer. The waste matter travels naturally from the bathroom to a compartment located in the basement, where it is stored and is eventually chemically converted into a granular brown substance that can safely be sued as fertilizer.

Bathing consists of a set of jet-spray fine-mist nozzles connected to conventional faucets, and a Japanese bath, constructed from an old beer barrel. A conventional bath can consume 20 gallons or more of water. So the inhabitants of the house minimize their water usage by banning regular baths and cleansing themselves by taking showers. And when showers are taken the in the experimental home, the jet-spray nozzels and the Japanese bath are used. The fine spray nozzles work on the principle that hot water will make you sweat. So the water from the fine-spray mist opens your pores. Than you submerge yourself in the cooler Japanese bath to totally cleanse yourself. In this manner you only use a few quarts of water, rather than the 20 or more gallons necessary to take a bath or even the one to seven gallons usually used for a conventional shower. No soap is ever used, as the jet-spray mist is also used to cleanse the face and hands in normal wash-ups. The theory here is that the dirt on your skin can be powered off by the jet-spray, and a detergent is unnecessary as it would pollute the recycled water supply.

At times, Project Ouroboros is referred to as the University's "solar home", but this is actually a misnomer. Holloway, the director of the project, says that he "does not feel that solar power is necessarily the ultimate power source of the future." So the "solar home" also has a windmill adjoining it. The windmill uses a two-blade, high-speed propeller, 15 feet in diameter, hooked into a five kilowatt generator providing 110 volts of DC electricity. Extra energy is stored in 58 two-volt batteries, stored in the basement. In the case of the experimental home, Holloway feels that "wind power will eventually supply all the electricity used in the house, via the windmill and generator."

Probably the first, and perhaps the most important question that comes to mind when viewing the experimental home, is whether or not the designers consider this to be a realistic alternative to the present day energy-squandering American lifestyle. Holloway emphatically denies this assertion. "Project Ouroboros", he says, "is not a prototype for a suburban home. It is more of a laboratory for various tests. And we will not hesitate to rip out something that does not work." So the experimental home is

hardly a model for the future, but rather a testing ground for the present—testing out a great number of potentailly feasible energy - saving devices and concepts.

A student who is currently working on the project, Tim Figge, pointed out that "we are a very service oriented economy. We are very dependent on others to provide services for us. This home gets away from that idea."

In fact, rather than coming up with new, revolutionary concepts for saving energy, the designers of Ouroboros have actually used very little that is new. The sod roof, windmill, heated crushed rock, Japanese bath and glorified outhouse are hardly new ideas. Holloway agrees with this, saying that "there is actually nothing new in the house. The technology used in it has been available for a long time. It's just that here, the ideas are integrated in a new way."

Project Ouroboros does have a Phase Two, which is already in motion. The goal of the second project is to remodel and apply energy saving devices to an existing structure, rather than design and construct a totally new building, as was done in the case of the present experimental home. This notion is well in the line of the thinking of Holloway, who does not feel that there will be a great deal of new building in the future. "Rather", he says, "we should be applying energy saving devices to existing structures." So at 1020 Laurel Avenue in St. Paul, the Project has taken over a building constructed in 1910 and is presently converting it into a 1975 energy conscious structure.

Will it work? Who knows. At least it seems to be worth a try. As Holloway sums it up, "The University is a time and a place to make some mistakes and try some daring research. You should not have to wait until you have a doctorate before you begin to experiment."

The Rosemount home will be closed from late January through May so that tests can be made to evaluate the effectiveness of the various energy-saving ideas. We will keep you posted on the results, because they should prove to be interesting. □

Paying the Bill

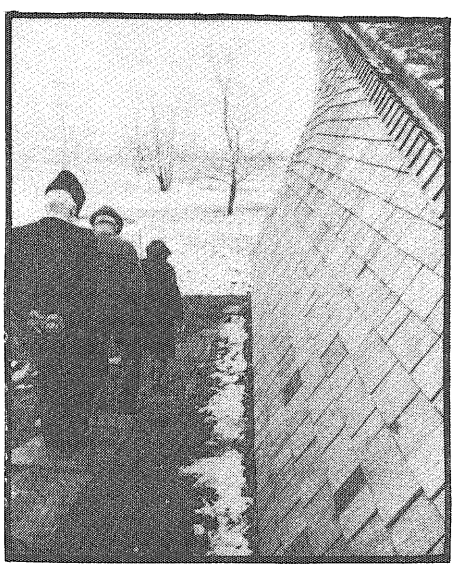
If any idea is to ever become a reality, one factor usually has to be considered: money. "Who is going to pay for this?" is a question which must be answered or a project such as Ouroboros would be reduced to a mere paper exercise.

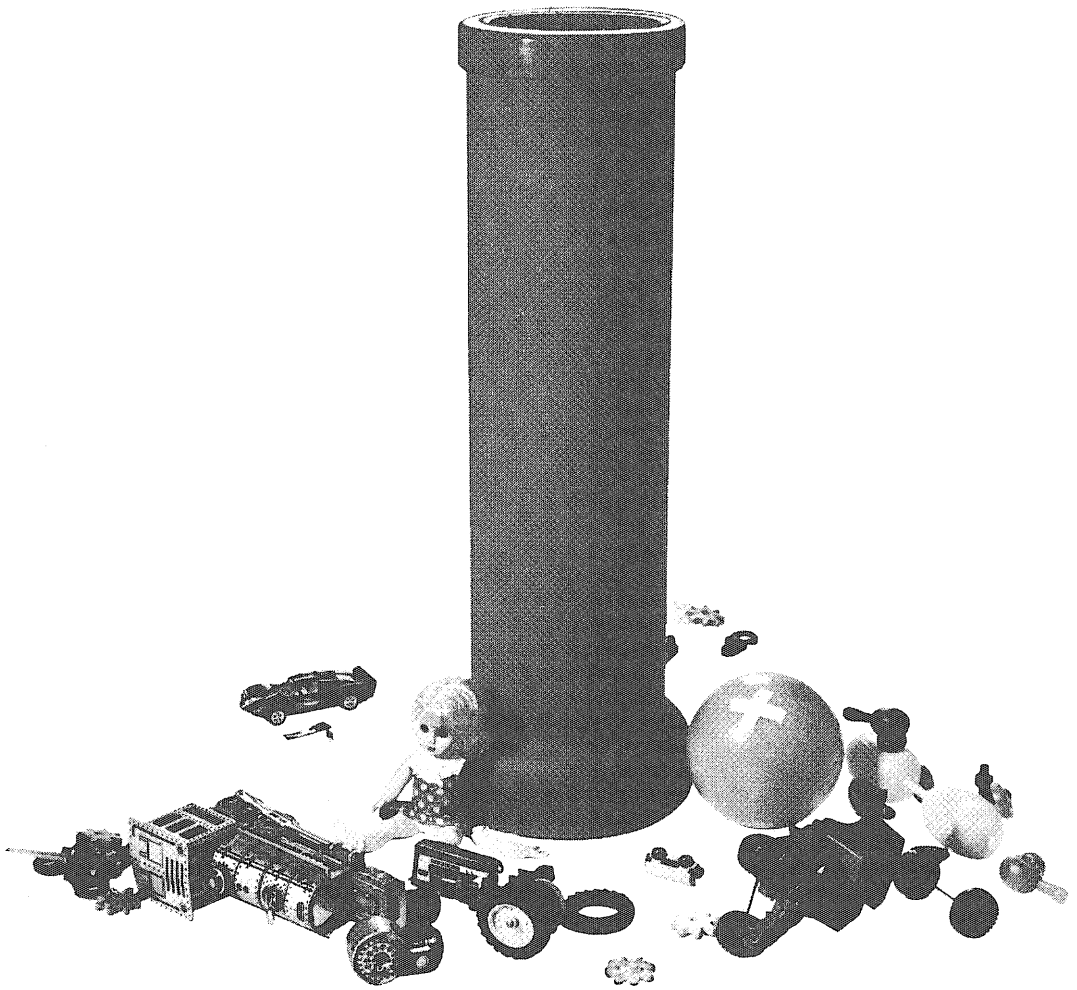
According to Tim Figge, a student who worked on the project, the experimental home, if produced conventionally, would cost between $125,000 and $150,000. Luckily, Project Ouroboros had a number of cost-cutting factors working for it. The land was donated, the architectural and construction plans were produced as a part of the project and the students themselves performed all of the labor. Still, the building materials and furnishings are worth nearly $90,000 and the Project is roughly $10,000 in debt, according to Figge.

Is this house actually worth the $150,000 price tag or is this a deceivingly inflated figure? According to Prof. Dennis Holloway, the expense of the experimental home is indeed deceiving because many of the items in the home would not ordinarily be there except that they were donated. According to Prof. Holloway, "I have a unique funding operation. I deal exclusively with local foundations and ask them for anything we can get. Usually, they give us the best items that they have, so that they can get their names somewhere on the home."

These local dealers and foundations have donated to Project Ouroboros to the tune of $80,000. There is a list in the front doorway of the experimental home, which contains the names of those local concerns who have contributed to Ouroboros. This list reads like a whos-who of local industry, even though many of these donations were of dubious value to Ouroboros. Holloway noted that "there are many quite expensive materials given to us, which we ordinarily would not have used." For example, there is an electric dishwasher in the experimental home. Such a luxury seems to be particularly out of place in an energy – conserving home and it would not be there except that it was donated to Ouroboros by General Electric. And so the story goes.

Some items simply cost a great deal of money and there is virtually no way to get around this fact. The solar collecttor, for example, costs between $3,000 and $5,000. Yet, to accumulate $80,000 in handouts during a period of recession and cutbacks remains quite a feat. Prof. Holloway should be congradulated. He might also let a few other people,like C. Peter Magrath, in on his technique.





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INFILTRATION & INFLOW in sanitary sewers

Sanitary sewer systems from Hibbing to Brooklyn Park are plagued by clear water, which floods the system during rainy weather and causes backed up sewers, forcing the dumping of raw sewage into rivers and lakes.

The problem is as old as sewers, but new techniques and antipollution laws are enabling engineers to bring it under control. The author is a vice president of American Consulting Services, a Minneapolis engineering firm engaged in sanitary engineering.

By Thomas J. Clark

Infiltration/Inflow, the entry of extraneous clear water into sanitary sewer systems, is not a new problem. In fact, engineers and municipalities have known of its existence almost since the time sewer systems providing separate flow paths for sanitary and storm water have existed. In spite of this fact, little has been done over the years to analyze the sources of this phenomenon in order to correct the situation, mainly becuase the technology to do so has not been available until within the past ten years.

The results of Infiltration/Inflow in sanitary sewer systems include the bypassing of raw sewage into rivers and lakes, backed-up basements providing storage for the extra water, severely overloaded sewage treatment facilities unable to properly treat all of the water they receive and overflow of manholes allowing untreated sewage to flow into the city's streets.

On October 18, 1972, Public Law 92-500 was passed by Congress and subsequently signed by the President. Entitled the Comprehensive Water Pollution Control Act, it incorporates a requirement that all sewer systems be shown to be free of excessive infiltration/inflow prior to the construction of a treatment works facility. This law has resulted in major efforts to educate the engineering profession on the ways and means to find and correct these problems. The major source of this education has been the rules, regulations, and guidelines of the Federal Environmental Protection Agency.

Sources of clear water: Infiltration/inflow is the sum total of extraneous clear water which may find its way into the strictly sanitary sewer system. Infiltration is that portion of the flow which can be found entering the sewer pipes and house services through cracked and broken pipe and poor sewer joints. It comes from a groundwater table that is higher that the sewer system itself and the sewer system acts as a french drain. Inflow, on the other hand, can be attributed to sources of direct connection between the surface runoff occurring during rainfall or snow melt and the sewer pipes themselves. Typical inflow sources are roof downspouts connected to footing drain tile surrounding the basement foundation, storm catch basins connected directly to the sanitary sewer system yard and area drains, sanitary manholes located in low areas accepting surface runoff and transference between open jointed storm sewers and sanitaries which lie below.

Infiltration is usually a sustained flow into the sewer system which may continue for weeks at a time or, in some cases, on a continuous year-round basis. It becomes very expensive to handle because of its long duration. Inflow is usually associated with rainfall occurrences and is of relatively short duration but usually of much higher magnitude with peak rates as much as ten times normal dry weather flows.

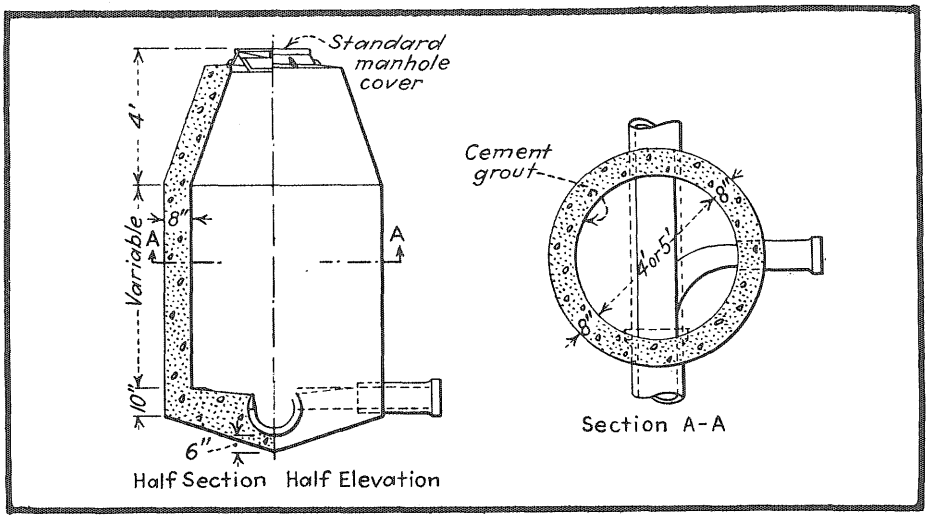
The Environmental Protection Agency, in its rules, regulations, and guidelines, requires that the problem be attacked utilizing a three step process. This is to conduct an Infiltration/Inflow analysis, a Sewer System Evaluation Survey, and the Rehabilitation Program. These major steps are separate and distinct, and each must have the approval of the EPA prior to the commencement of the succeeding step.

Preliminary analysis: The Infiltration/Inflow Analysis is an over-view report designed to define the infiltration/inflow problem in terms of its size and in terms of its possible sources. It is further a discussion of the alternative solutions to the problem such as accommodation of all or part of the flows at expanded treatment plants or in detention basins.

The analysis is conducted by gathering all of the data availa-

ble from the community through p.atterned interviews and limited field studies. Of importance in terms of data collected are flows at the treatment plants during all climatological conditions, system problem areas, observation of typical cources through limited field investigation, and geological and geographical characteristics of the area.

The engineer conducting the infiltration/inflow analysis must estimate the cost and means of reducing the flows through system rehabilitation. He must further estimate the cost and means of accommodating both the entire flow and those flows which cannot be economically removed through system rehabilitation. He decides finally whether any part of the clear water finding its way into the sewer system can be removed at a lower cost than it can be accommodated at the treatment plant. If the engineer finds that this is in fact the case, the system is deemed o to be possible possibly excessive. If the conclusion is that no part of the system may be rehabilitated for less than all of the clear water can be accommodated, then the conclusion of the report is that the infiltration/inflow is non-excessive. In general, a sewer system subject to a high degree of inflow will almost always be possibly excessive. If the system has little or no inflow component, it may be non-excessive because the cost of finding and rehabilitating infiltration is frequently higher than the cost of accommodating the same flows through treatment plant expansion.



Typical sewer manhole. Note channel on bottom for flow of sewage.

Sewer system evaluation survey: If the infiltration/inflow analysis shows that the sewer system is possibly excessive, a detailed, step-by-step program to locate as many individual sources of clear water must be undertaken. This is called a Sewer System Evaluation Survey and is comprized of four major phases. They are: (1) physical survey, (2) rainfall simulation, (3) cleaning and television inspection, and (4) analysis and recommendations.

The physical survey entails the descending of each sanitary sewer manhole in the area to be studied for the purpose of inspecting the conditions of the manhole and all sewer pipes leading to and from the manhole, and locating infiltration sources which can be viewed from the manhole. The inspection involves lamping, or viewing the inside of the pipes with a periscope, and conducting a thorough physical inspection of the street surface which surrounds the manhole and lies along the length of the sewer pipe. Many large sources of clear water are found during this phase, especially those associated with inflow conditions. The physical survey also identifies additional work which may be required in the succeeding steps.

Rainfall simulation is a means to simulate actual rainfall conditions in the system on a step-by-step basis. Normally, the engineer cannot properly identify the characteristics of storm water entry merely by being present during a storm. So much is happening everywhere that it is impossible to pinpoint exact source locations. Rainfall simulation is accomplished through the flooding and plugging of storm sewer sections which lie above and are either parallel to or cross over the sanitary sewer system. If the storm sewer system exfiltrates clear water through soil and into the sanitary system under these conditions, the existence of this during actual storm occurrences is verified and those particular sections are qualified for closed circuit television inspection in the succeeding stage.

Smoke testing may also be used as a part of rainfall simulation in order to locate and verify sources of clear water on private property such as downspouts and yard drains hooked into the sanitary sewer. It may also be sued as a pre-qualifying technique to determine the need for rainfall simulation in the public portion of the sanitary system. In this procedure, smoke under a slight positive pressure is inserted into the sanitary sewer system and the system is monitored for the exit points of the smoke. If the smoke only exits at the vent pipes in the houses and not through any other locations, it may be presumed that additional sources of inflow into the system do not exist. Care should be taken in smoke testing, however, to insure that the sources are not missed because of traps in the system which prevent smoke from finding its way to the actual sources of clear water.

Cleaning and closed circuit television inspection are done only in these areas and those runs of pipe which have been prequalified by findings in the sur-

vey in the rainfall simulation stage. Closed circuit television inspection is a means for pinpointing the exact location and quantity of individual sources of clear water within a run of sewer pipe that may not be visible by lamping from the manhole. Television inspection must be performed under the same conditions which originally qualified the line for inspection, *i.e.,* rainfall simulation or high groundwater table.

Cost-effective analysis: With the completion of these initial three steps, the engineer has located and quantified each source of clear water entering the system which is locatable by these techniques. He must then assign a cost to correct each of these individual sources and must then place these individual sources with their costs in a cost-effective order for analysis. This cost-effsctive analysis is really an incremental analysis which compares the cost of removing each source of clear water (starting with the least expensive in terms of cost per gpm) to the cost of transporting and treating that same parcel of water by some other means.

Somewhere in this analysis the engineer will arrive at a point where the cost to remove the next most costly parcel of clear water will be more than the cost of transportation and treatment of that same parcel of water. From that point on, all clear water which is more costly to handle will be determined to be non-excessive and treatment and transportation capacity will be provided to accomodate it. All water found to be cost effective to remove will be included in a program of system rehabilitation which will proceed with the treatment works construction.

Figure 1 represents a typical decision model associated with the cost-effective analysis just described. The accommodation curve represents the cost for accomodating infiltration/inflow at any given decision point and rehabilitation curve represents the cost of rehabilitation to any given decision point. The assumption is that 100% of the infiltration/inflow existing in the system will be taken care of by some combination of rehabilitation and accommodation and that for any decision point there will be a specific combination of rehabilitation and accommodation costs. The object is to choose the decision point which will result in the least expensive total program. The total cost curve, which is an algebraic sum of the accommodation and rehabilitation curves, shows a minimum total cost point, *m*, and this then becomes the decision point for the engineer. This decision point directs him to the proper amount of rehabilitation and the proper amount of additional treatment capacity to be provided the handle infiltration/inflow.

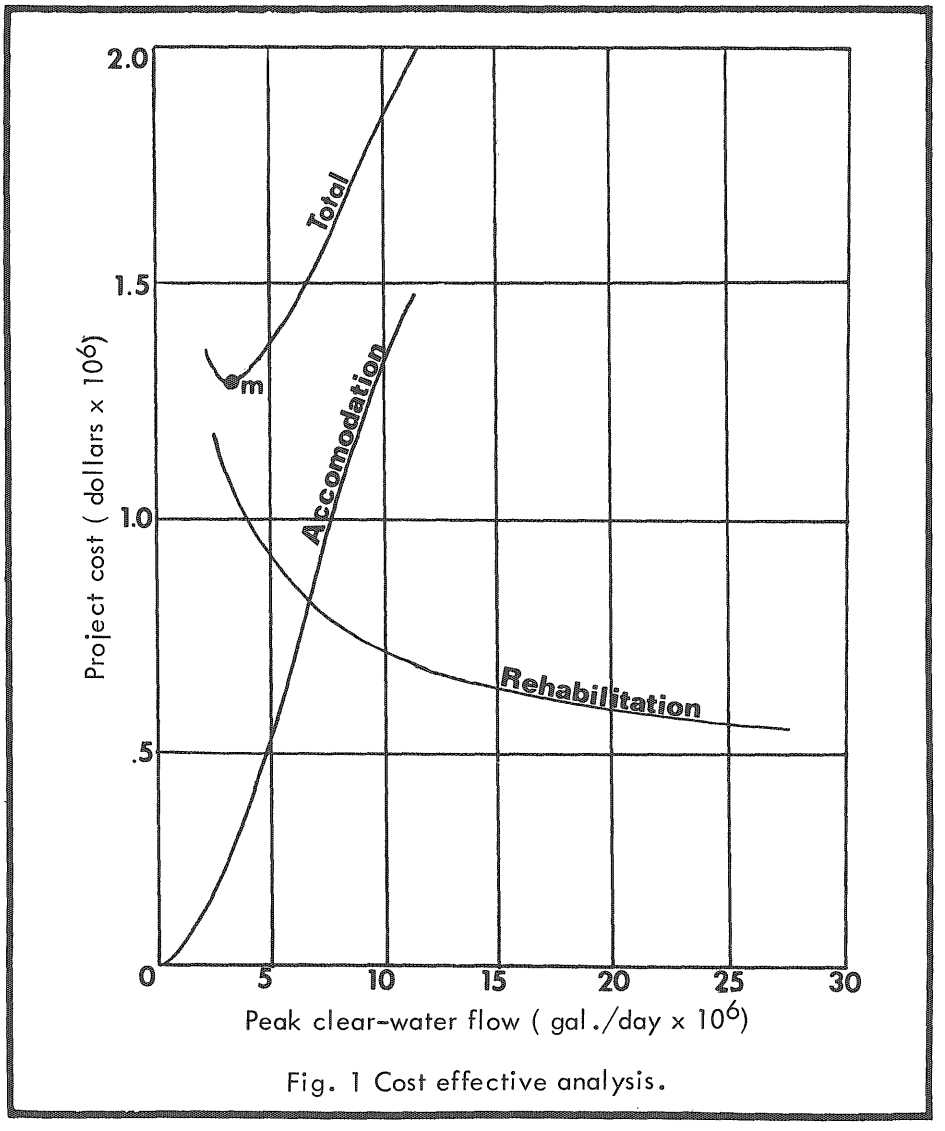


Fig. 1 Cost effective analysis.

So far, we have considered only the problems of clear water within existing sanitary sewer systems. It is just as important to insure that new sewers are installed in such a manner as to preclude the intrusion of clear water. This is accomplished by writing adequate specifications for the installation of new sewer pipe, the institution of proper ordinances to prevent connection of sources of clear water to the system, and proper inspection procedures on the part of the communities to insure that the ordinances are followed. The cost of this inspection will be paid back many times through the prevention of costly clear water flows to the treatment plants of the future.□

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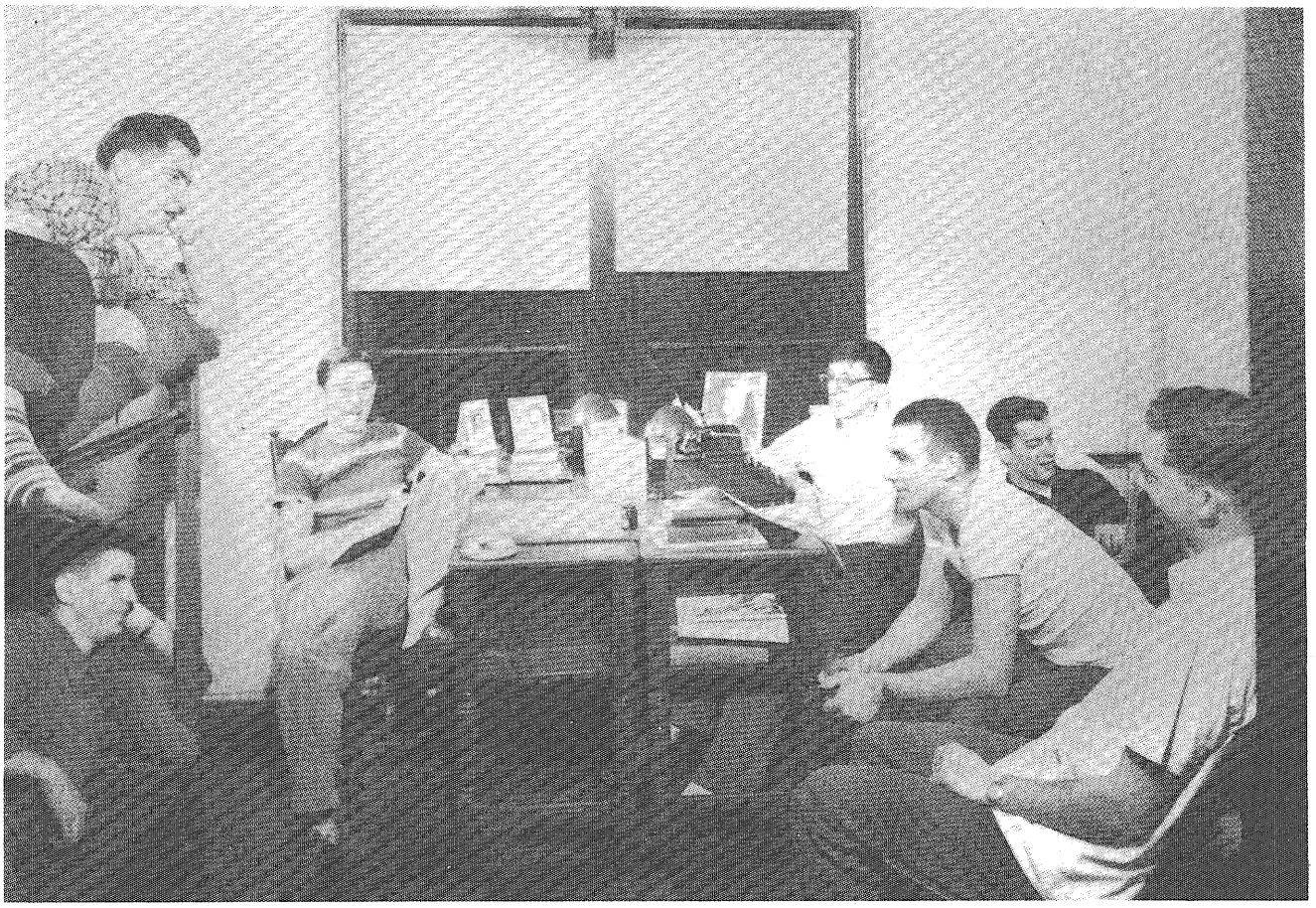

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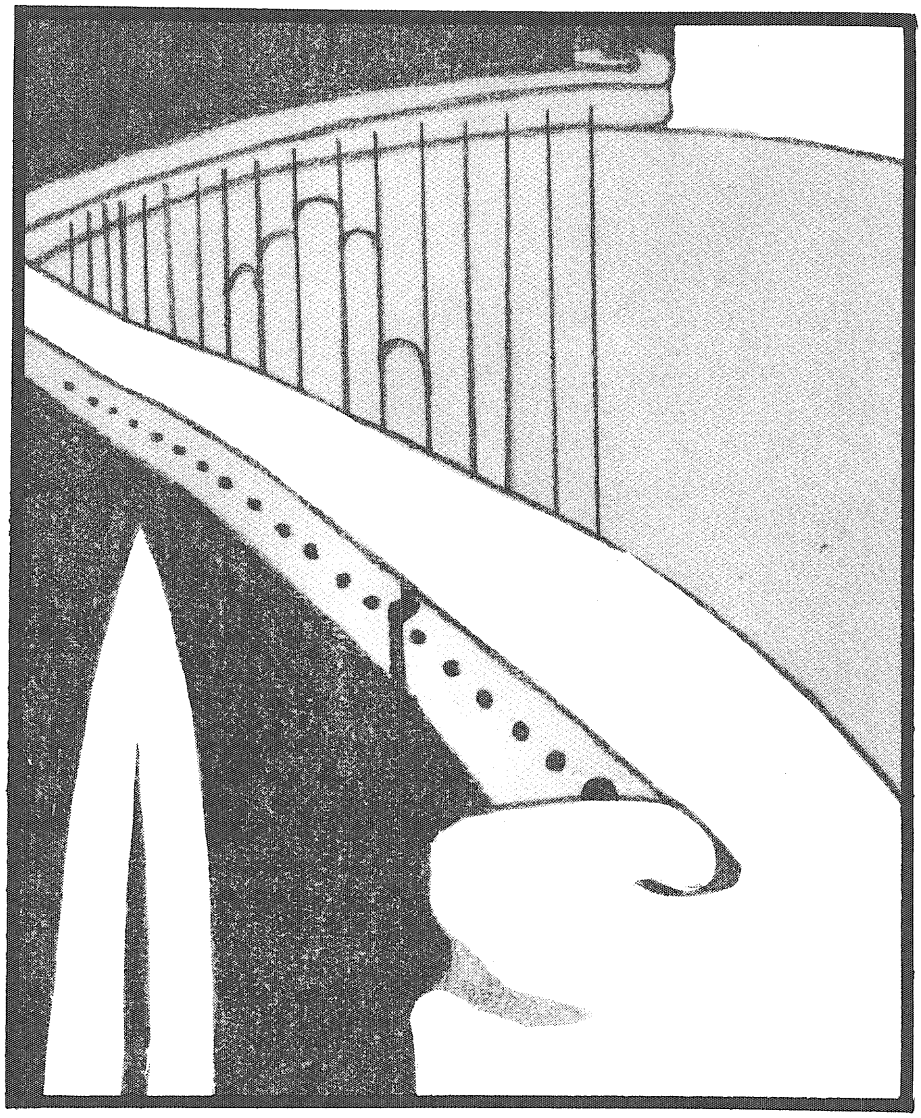


Silver Strings

By Francis Roy Waldo

In the nether lands, where the fudge factor lives and reproduces, unicorn talk, dreams kill, and men sing the sorrowful saga of Brendican's death. In our own world, where fantasies of fiction often merge with reality, the Technolog *is proud to present the winner of its annual and much acclaimed Science Fiction Contest. Intergalactic travellers from throughout the University community have committed to graphite their own glimpses into these uncharted worlds, and the editors have selected the finest apparition for publication.*

The scene is the city of Kesh, akin to pre-truce Belfast. The ravages of tyranny and combat have reduced this village to a feudal fiefdom, ruled by the evil MalMordha. But love still reigns supreme in the hearts of men, and has brought together a troubador from Fermanagh, and a sword-wise wench of the Southern Clan. Fate has thrust them directly into the doom of MalMordha, who can only wish that he had finished them off when he had the chance.

The Watergate appeals may last for years, and the ITT suit may stretch over decades. Justice today seems delayed and indirect. In the land of Kesh, retribution is swift, indiscriminate and often fatal. But how can the lonely minstrel Kegan achieve his blood-bound revenge? In his winning story "Silver Strings", Francis Roy Waldo confirms that music may indeed still soothe the savage breast.

It was harvest time, the dying time, the time of cool, crisp air, and royal hunts, when low grey clouds come down from the North, and all the creatures of the earth make ready for the coming of winter. The days were but ghosts of their former selves, short-lived, and chill, with hoar-frost in morn. Late-summer flowers lay withered and brown along the roads.

The wind, like a herald of some mighty king, swept over the land, trumpeting, blustering, proclaiming the news to

every chimneypot, tower, and falconer's mews, and rattled the windows, tore slates from the roofs.

In the grain fields that surround the city of Kesh labored the farmers, as numerous as the ants underfoot, and like the ants, busy reaping the wheat for use in the long, bleak months ahead. They worked at frenzied pace, for the raw wind that whipped about them forbode colder weather soon to come, and urged them on to a speed which even beaten slaves in nearby fields failed to match.

Through the tossing amber sea, like ships a-sail, passed two on horse, aloof and withdrawn, unseen but for an occasional farmer who straightened an aching back and cursed those who dared to waste such precious time. Had he been closer, he would have wondered on what remnant of an army did he spy, so alike in attire were the two. They were covered, head to toe, in fabric dyed a rich blue, the blue the heavens take on at dusk. Trews, blouse, and cape, all blue, and in the rushing wind they seemed to be twin shards of a fallen sky, torn loose, and held captive by the earth's weighty grasp, yet ever struggling to escape. From within folds of the indigo cloth came the gleam of sword-steel.

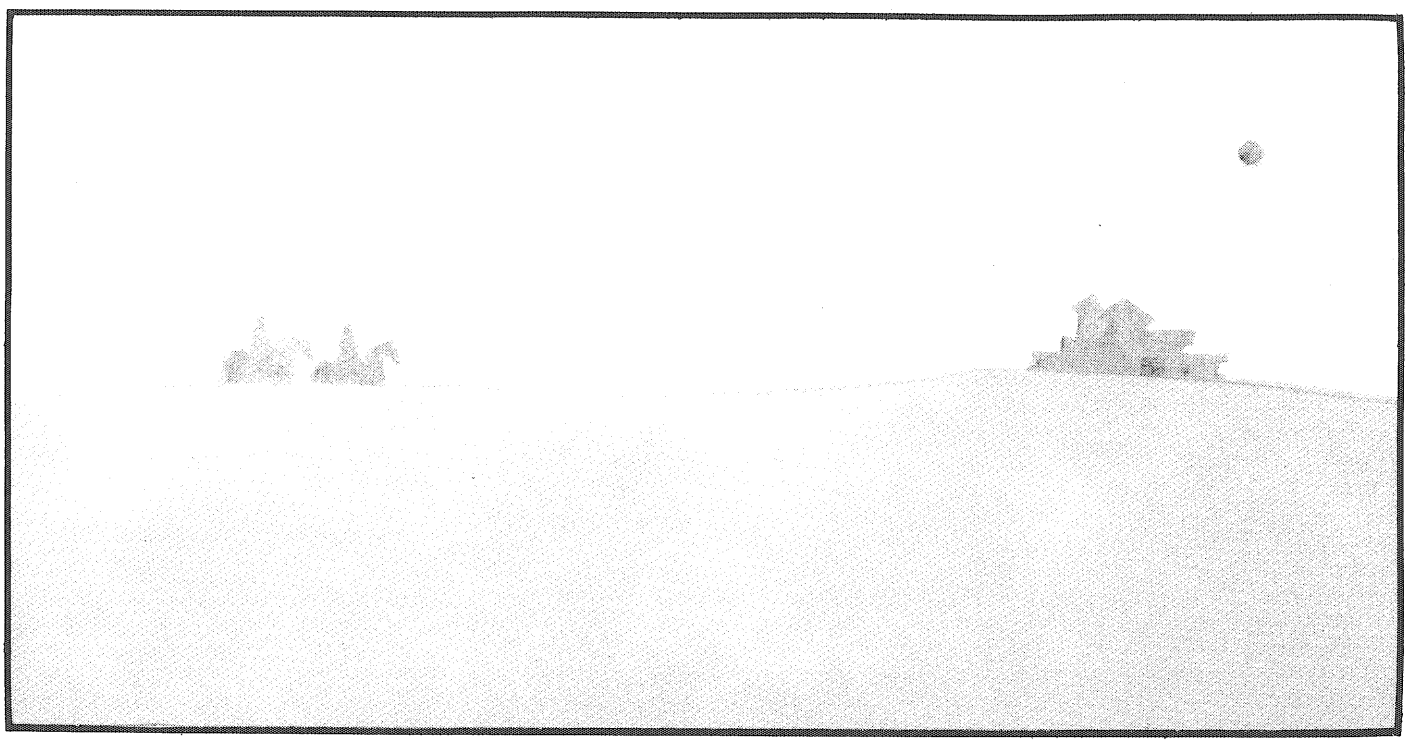
Mile after endless mile they covered, neither speaking nor eating, nor resting their mounts. Their only companion was the Air-That-Moves, gusting, sometimes wafting, often pounding, but always blowing. The cold air bit into their faces, stinging all the more for the grains of sand held in its grasp, so great was the speed at which the wind now blew. Against it the two sought protection by wrapping themselves tightly in burnooses, so that only their eyes were exposed. But the Wind, whose curiosity overwhelms the giants of the forest, toppling the trees where they stand in its path to see what treasure lies beneath tangled roots, this same Wind tugged and pulled and played at the veils, and once completely blew them aside, and revealed the foremost face to be that of a woman's. Now indeed would any inquisitive farmer marvel, for she rode astride her mount like a man, and rode as well as her male companion, perhaps even better. Like him, she had strapped to her side a sword, one of the needle-thin kind used to the south, in the land of the Clan. Her skin was the color of desert sand; her eyes seemed hard as desert rock.

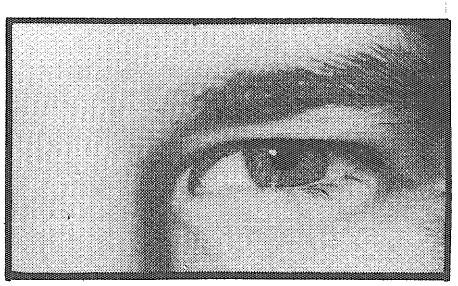
Her consort was about the same height as she, and likewise slender. A Clan sword hung from his waist also, and to his thigh a knife was held by sapphire cloth. His pale skin which showed no sign of the sun's stain marked him as from the North. Half-hanging, half-seated in a saddle boot was a troubadour's harp, covered to provide some measure of safety to the strings.

It was dusk before they reached the walls of Kesh, and a gallop was necessary to enter ere the bronze gates were closed 'till morning's light. The howl of the wind dropped as they rode into the comparative calm that the great bulk of Kesh provided. In the near silence they could hear the din of numerous voices. The sound seemed to originate from the Merchant's section of the city, and wavered up and down as the two headed their mounts in that dir! ection.

"Mayhap MalMordha seeks taxes this night?" murmured the woman.

"Nay Deidre. There's not anguish enow in the screaming. It seems to me more like a Keshite attempt at celebrating—five to one the Duke is dead."





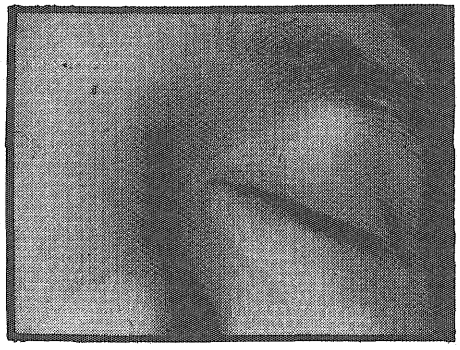
"Taken, Kegan, with food, bath and bed thrown in, and the loser pays a week of it."

Their wagering was interrupted, for they had entered the bazaar, and sights and sounds of all description assailed them. Tents and stalls and booths of every shape and size filled the market place to overflowing. In the light of a galaxy of torches milled countless revelers. The two travelers looked about in

astonishment.

They rode at snail's pace through the crowd, allowing themselves to be swept by the current, taking in everything. Finding an inn, they lodged their horses, and then sought refreshment.

Inside they ordered food and drink, and from the inn-keeper obtained an explanation of the city's transformation: MalMordha was off on a hunt, they were told, and not due back for another week. In the meantime, the people of Kesh sought to make the most of his absence. The merchants, self— sacrificing lot that they were, decided a fair would be the perfect thing, a civic minded endeavor, with feasting, drinking, entertainment—what a picture the inn-keeper painted. After paying two prices to reserve a room, the travelers picked a table to their liking, in a dark corner, with a window nearby for a quick escape if the need



should arise. They then attempted to empty the tavern of food and wine.

It was in the middle of their third or fourth flagon—later Kegan could not recall, and Deidre did not care— that the trouble started, and in a wholly unexpected way. The .. harp on Kegan's back had evinced no little interest when they had entered, for musicians, be they good or poor, are always scarce, and scarcer still in gloomy Kesh. So it was no surprise when several merrymakers approached, and set on the table an unopened bottle.

"By your leave, minstrel, but might we trade this wine for song?" The harpist's mouth tightened in a small smile as he looked aside to meet the woman's eyes. They bent forward, debating with mock seriousness the offer.

"Should we perhaps throw in my dance, and charge them what we did Prince Alban?" suggested Deidre.

"Perhaps," was the answer, "though they hardly look to be the sort who'd own fine stones." The Northerner was fondling a small bag of gems as he said this. "I'll wager Alban has not missed them yet, but counts his many other jewels, instead."

"Aye. Much better use they'll get from us. But what of these fellows?"

"We've money enough for now, why charge them?"

"Kegan! You'll spoil them, no doubt."

"Hush, love, we'll accept the wine, of course."

So Kegan set the harp upon his knee, and played a song of his native land, while Deidre danced with unbridled delight. The music set toes to tapping, the dance caused eyes to stare with wonder. Both performers and audience enjoyed themselves immensely.

During the dance a group of soldiers entered the room. They wore MalMordha's liverie. Four gave Kegan but a passing glance, a lengthy stare at Deidre, then settled down to drinking. But the fifth, a man of the Northern desert, watched Kegan closely, observing his fingers upon the strings, the pale skin. When Deidre finished her dance amidst enthusiastic applause, the soldier approached their table, to stand beside kegan, carelessly holding a tankard.

"You're of Fermanagh?" It was more a statement than a question. Kegan nodded his head in casual affirmation, wondering how the soldier had known. Few this far south had ever recognized him to be Fermanan, and those only in broad daylight. To be identified in the near-dark chambers of a tavern was astounding.

"I am, You know of it?" The soldier ignored his words to continue on, the gleam of obsession showing in his eyes.

"Around many a night-fire I have heard tales, of songs that kill, Fermanan songs...cursed harps played to work the will of human fiends." The conversation had taken the turn Kegan had feared it would. His curiosity had been piqued by the man's recognition of him, but he didn't like prying strangers' questions, nor public diatribes such as he was now recieving. With the speed of a striking viper he cast his dagger, to have it sink quivering in a timber by a bottle of ale.

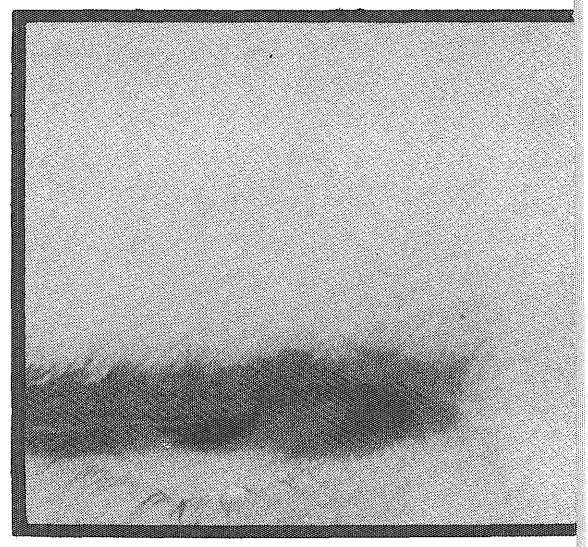
"That bottle, 'keep, for my imaginative friend here." Then to his "friend": "Think you, soldier: were that my harp a-quivering, we'd have glass on the floor, and dry throats. And harpstrings be much too short for strangling."

"You mock me! Rat's eyes or harps, you're still wizards, you Fermanaugh! All of you, filth!"

Following invectives were lost as Kegan's fist sounded against the man's jaw. He was still falling as the whole room erupted into chaos. The duke's guards drew sword and went to the aid of their companion. Deidre jerked her sword, sheath and all, from her slim waist, and grasping the end, swung the hilt full force down upon the nearest hostile head. Then, freeing her sword from its scabbard, she used both blade and cover to fend off blows from the others of the duke's men. Parrying a thrust, she turned to see Kegan busy turning a chair to firewood with the help of a guard's head. Several drinkers shouted encouragement, ad pummelled a guardsman who tried to bring up his bow.

One patron, a fat little man caught up in the spirit of the fight and inspired by Deidre, likewise grasped his sheathed blade by the end, to club a charging soldier. But as he raised his arms the sword flew out, its hilt crashing against the wall. The resulting love-tap only served to make matters worse. Excess weight was about to be lost, and heighth that could be ill-afforded, when a well-aimed bottle smashed into helmeted head. The fat one turned to proffer thanks, just in time for his face to greet a second flying bottle, which sent him reeling to the floor. From behind the bar came a roar of triumph, as the barkeeper grasped another missle, ready to teach more rowdies the dangers of disturbing his grog-shop.

By now Deidre and Kegan had met at the tavern's door. The last of the duke's guard was groaning on the floor, while calmer customers resumed their discussions. Across the field of fallen heroes,



Kegan waved cheerfully to the raging man behind the high wooden bar.

"Ho, 'keep, my blade, and quick about it." The inn— keeper's face turned bright red, then deep purple. He jerked the dagger from the wall and threw it. Deidre was already out of sight, and kegan stepped back to follow her, pulling the door before him, as the black-hilted knife thudded into the panel. Then a hand slipped back into the tavern to retrieve the knife, and pale fingers waggled farewell. A string of curses followed it out into the dark. Laughter floating in from the street came in answer.

Kegan and Deidre sat high above the streets of Kesh, perched precariously atop the peaked slate roofs with an air of nonchalance. The now-revived soldiers and their hastily— summoned comrades charged up and down the alleys and streets, shouting and waving sputtering torches, their voices finally fading into the distance. Deidre spoke:

"They're leaving now. Shall we go down?"

"So soon? Perhaps they've still another trick to show. I liked it when those two ran into each other and set their clothes

afire."

"Aye, you nearly rolled into their arms from laughter." But Kegan stood up, nevertheless, and within minutes the two were finding rooms elsewhere. And soon they were sound asleep, fighting the brawl again in their dreams.

During the night Deidre was awakened by Kegan playing his harp. There was not one candle lit, and he played so quietly that the swish of the strings vibrating through the air almost drowned out the tune. In the dark the strings sounded like the chiming bells of some strange temple. It seemed as if he had not played the song for many years, for he would pause now and again, as though trying to remember what came next. Then the strings would sound again, continuing the erie tune that mourned for days past, the long ago.

As Kegan played, he sang, so quietly

that Deidre heard few of the words. But what she heard sent chills up her spine, making her shiver though she was covered with sleeping furs:

Damned to see Death's icy stare,
to live the one who dares,
Thrice-curst the one who this song sings,
to bring forth Hell on silver strings.

Finally the harpist stopped. Deidre heard him lay the harp aside, then the rustle of furs as he crept beside her. Yet she said nothing, but lay awake long afterwards, thinking over what the soldier had said in the tavern.

The following morning found Deidre and Kegan out in the bazaar. They strolled through the square sampling the tastes and sights of far-off lands, gathered together in the most unlikely city of all. Once, when the two came upon a wandering minstrel, Kegan made a crude remark concerning musical ability, but a look from Deidre kept it soft enough to avoid starting trouble.

It was near noon, while the Fermanan and the Clanswoman sat in an open space, just watching the multi-colored crowd, that there came a trumpet blast. Kegan and Deidre looked at one another in puzzlement, then at the multitude. A shudder seemed to pass through the crowd, and the next moment the foreigners sw why. In the street that lead from the gates of Kesh to the bazaar there appeared several score of armed men, and at the head MalMordha. This was the meaning of the trumpet; the signal that the ruler of Kesh had entered his city, the city which he kept by the might of an iron fist. Here he was, days early, and viewing a sight which he would never have permitted had he been present.

His subjects had fallen silent, motionless, watching to see what their master would deign to do. MalMordha stood in his stirrups, and shouted in a voice that carried to all the corners of the bazaar.

"My beloved, what is this I find? Celebration? While I am gone on an empty hunt. What are my men-at-arms to think, that you celebrate an empty hunt? Fie on you, to make my men-at-arms think such." MalMordha turned, to face his soldiers, and like a sentence of execution his words floated to the crowd. "To the hunt!" Then he wheeled his horse, and charged into the bazaar.

In the center of the square sat Kegan, his mind refusing to accept what his ears had heard MalMordha say. About him, the crowd fretted as the horsemen bore down on them. Then the silence was broken as panic seized the people, sending them scurrying for safety. A shadow flitted past him and he felt Deidre tug his cloak. He ran with her, heading for the cover provided by the nearest booth. The screams of those first set upon reached them. From behind came the thudding of hooves; all hope of sanctuary was lost.

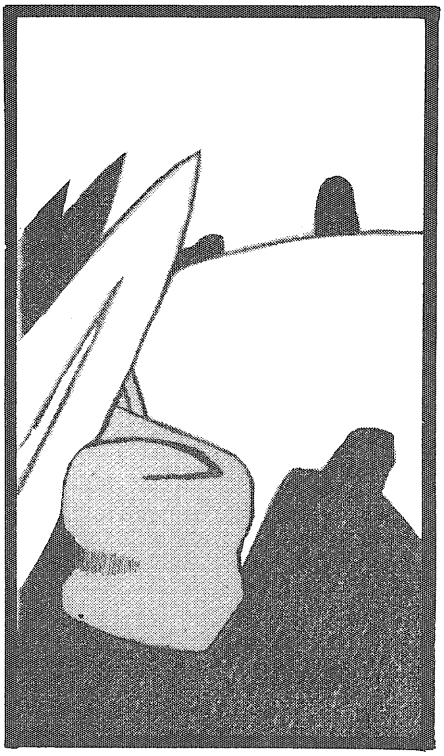
"Stand and fight" Deidre screamed. Her sword flashed as it was pulled from the scabbard. Kegan had scarcely freed his own when the first horseman was upon him. He dodged the hunting lance, only to face another rider, this one brandishing a sword. He eluded the swing, then buried his sword into the exposed side of the man. Before he could withdraw his blade, it was broken by the momentum. He threw the hilt after his dead foe, and ran to retrieve the dropped sword. He smiled as he grasped it: a soldier's broadsword, good for swinging, and not just thrusting.

The soldiers were everywhere, killing without mercy. Deidre had managed to find some protection amongst the booths where she had been forced by the crowd when the soldiers first charged. Now she waited for individual guards, stepping forth from a tent to slay them when they passed by searching for prey. She had just disposed of another in such manner when a horseman spotted her in the small alley formed by the rows of tents. She barely reached her refuge in time to throw herself down upon the ground when a sword slashed through the canvas at head level. She jumped up, sword in one hand, scabbard in the other, and ran from the tent in the opposite direction the horseman had gone, to seek Kegan.

From all around the bazaar came the sounds of dying, the stench of death. Kegan hadn't noticed when he and Deidre had been seperated, but a lull in the fighting came, giving him an opportunity to search for her. The few horsemen who still remained were busy chasing survivors at the other end of the bazaar. The harpist had reached where he'd last seen the desert woman when he saw her come from among the tents. Then behind her appeared one of MalMordha's horsemen. He shouted a warning but she had already been alerted by the hoofbeats. At the last second she turned, ducked beneath the blade, and with a dancer's grace, thrust herself forward, catching the rider in the throat with her point. Now it was Kegan's turn to defend him-

self, as another horseman, this one from the far end, came to attack. Kegan evaded his assailant's charge with ease, letting loose a shout of derision as the horseman missed, to continue on in the direction of the tents. His jeer was cut short by Deidre's horrified cry. Powerless to help she watched as he was borne to the earth by the very horse she had robbed of its master seconds before.

In the darkness Kegan could hear voices calling to him. From a great distance they came, first soft as whispers, then growing louder, painfully louder, until it seemed they sought to crush him. Suddenly there came a burst of light, and Kegan was staring into the afternoon sun. With a start he remembered what had happened, and struggled painfully to his feet. Sensing that nothing was broken, he studied his surroundings. The bazaar had taken on the appearance of a battlefield. The once gaudy tents were but ribbons, the booths only bits of firewood. Here and there lay a body, unmoving, waiting to be placed on the cart with the others. In a panic he ran from one corpse to another, But Deidre was not among them, nor was she among those in the cart. A wild hope seized him; since the woman was not among the dead she must still be with the living, perhaps at this very moment in a nearby tavern, waiting for him to join her. But a whisper deep inside told him that was false, that only death would have prevented her from



seeking him as he sought her. Try as he might he could not still that voice.

The lurching departure of the hearse caught his eye, an with a growing sense of dread he followed it. Through the winding streets it went, and through the Gate of Kesh, to a spot overshadowed by the towering city wall. There a large pit had been dug, and in it were strewn the victims of MalMordha's hunt. More there were than four men's fingers, mute testimony to their ruler's madness.

Into this horror the harpist entered, slipping on the blood soaked earth. At one end several men were already starting to throw dirt atop the corpses, so he went over there to start his search. There he found her like a broken doll some careless child had left, lying in that ghastly heap. He stood for a moment looking down at her, as her name slipped from his mouth. He brushed the dirt from her face, and as a father lifts a sleepy child to carry it to bed, Kegan gently picked up Deidre, cradled her in his arms, and stepped out of the excavation.

Away from the city he walked, southward, his body numb to the biting wind. Later he could not remember how he had procured a horse, only that he had traveled until the roofs of Kesh were lost in haze, and the chaff-strewn fields met verdant forest.

There he ended his journey, to clear the rubble from a space of the fields, until the black dirt was bared. Then he took wood from the forest, to pile it up inside the circle he had made, until it dwarfed him. Upon the top of this, leveled and made smooth as possible, he laid Deidre. With one kiss he took his leave of her, and struck flint to steel. When the Fermanan was convinced the fire whould continue without further attention, he fetched his harp from where he had laid it, and seated himself so near the climbing flames as to be painful.

The sounding of a harp rolled out into the desolate Keshian landscape, filling the empty skies, sending nearby birds to flight. Kegan sang the lament for the dead, while the flames kept time to his words. He sang of her prowess in battle, her skill as a dancer. In heartrending anguish he sang of her passing; but the flames heard not, nor did they care, but flew skyward, taking his treasure with them. At the height of the fire the harpist could stand it no longer, and in despair tore the strings from his harp.

At length the flames weakened, and died out. Still Kegan sat there, keeping watch by the ash-mound until the last ember had winked out, the ground was cold to the touch. Finally he stirred. Driven by some inner demon he mounted his horse, and without a backwards glance rode in haste for Kesh.

Like the skeleton of some lost city, the ruins in the bazaar lay motionless beneath the brightening stars. The few figures gliding through it kept to the walls, seeking the protection of nearby doorways. Of these bodies, one was nearly invisible, dressed in cloth that matched the western sky. The skin was the color of desert sand, the eyes hard as rock. The hands were covered in gloves of blue. Upon its back was a harp. The figure wandered not at all, but went straightaway for the street where labor the silversmiths, which opens out upon the bazaar. From a single window shone light; to this the figure proceeded.

A small bell sounded as the door was opened. From a back room an old man came in reply. The stranger set his harp upon a table.

"I'm in need of strings of silver..." the foreigner began, but the smith cut him off abruptly.

"I'm sorry, my shop is closed 'till daybreak." The tan-skinned stranger continued as though he hadn't noticed the interuption.

"...I will pay whatever you ask." From within the cloak he drew forth a small sack, and laid it on the table.

"Are you deaf, man, I said I go home, now."

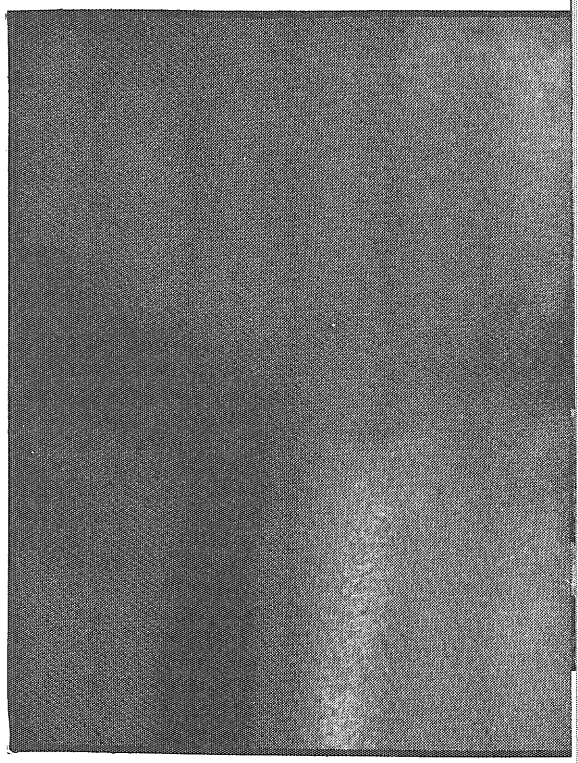
From out of the cloak there now appeared a dagger.

"And I said I have need of you, NOW."

The old man seemed ready to explode, then suddenly seemed to wither, and grow older.

"Please, sir, tomorrow, yes, and what time you will, but tonight I can't," the wrinkles deepened with each word, and his voice grew thin, "for tonight I bury my only son."

The old man walked to the single window that looked out on the bazaar. He stared with the intensity of one who sees



more than is before the eye. "He came to fetch me to midday meal, my son did, and I stood at this glass while MalMordha rode by. I watched as my boy was cut down like the wheat of the fields. He died alone, before I could reach him—I'll not be away as he goes in the ground!" Reflected in the glass, two diamonds sparkled from the old man's cheeks. Then the other spoke.

"Then we have both been wronged, old man, and robbed. My love didst die out there, as well. This night I seek MalMordha's death."

The reply was sarcastic.

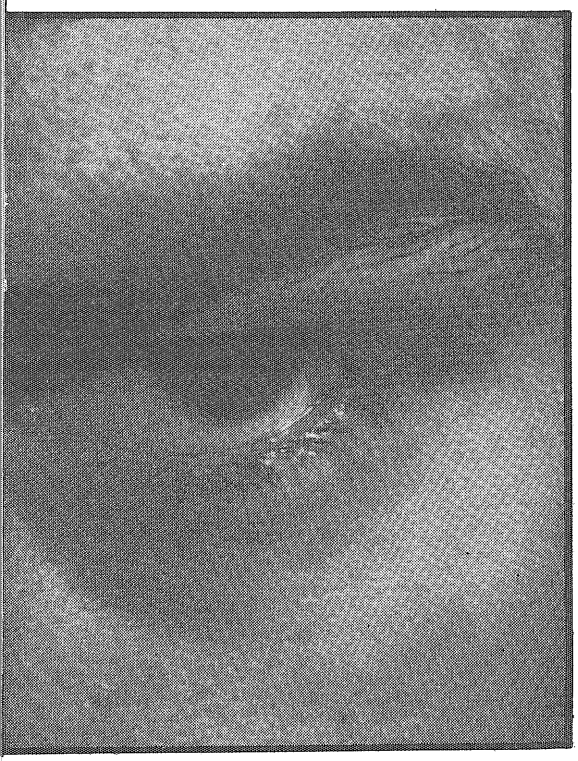
"With silver strings!"

The stranger removed the gloves from his hands, then rubbed at his face, to reveal pale skin beneath stain.

"Look at me, old man, and hear. Across the earth I've traveled, and ever have I heard men whisper 'Fermans play the Devil's tune.' What say you, old man, shall MalMordha dance to it this night?"

The ancient smith studied the sallowed face, and took the slim, long-fingered hands in his. Without a word he turned and left the room, to return a moment later bearing a silver belt buckle. "My son's" was all he said.

Then the two set to work, Kegan operating the bellows to keep the flame hot enough to melt the silver, stoking it when the need arose. The smith tended the melting ornament, making sure that all was completely dissolved. Then the



cauldron was set half-off the fire, allowing the silver to thicken slightly. Then the harpist spoke the lengths and widths he wanted, and following the specifications, the old man drew from the molten metal a wire, but was dissatisfied with it. He put it back to melt again. A minute later he drew another, this one met with his approval. The entire process was then repeated, and a second wire joined the first. There followed more strings in quick succession, each one shorter and slightly thinner than the string proceeding it. Throughout all this not a word was spoken, the old smith and the young harpist sensing the other's wishes, and fulfilling tem in silence.

At last the work table lay covered with a score and half of silver strings, scintillating in the flickering light of the smith's fire. Soon they were in place upon the harp. Still without a word, Kegan covered his face again with stain, and the two separated, to honor their dead as each was wont.

Through the darkened city slipped Kegan, melting into the night as the the air. The moon had scarce begun to rise when he reached the palace of MalMordha. Against the great iron doors he pounded his fist. A face that seemed more of a pig's than a man's poked its way into a small window set inside the door. The little eyes squinted at Kegan with loathing for having disturbed their owner's slumber. Kegan held up his harp and a ripple of music swept out from it. He spoke with the haughty confidence of the wandering minstrels.

"I wish to see MalMordha." The guards eyes vanished in folds of fat as he contemplated this. Kegan could almost see him weighing the benefits of earning MalMordha's pleasure at bringing such a prize to him with the risk of what might happen were MalMordha displeased. At last greed won out, and the face disappeared with a grunt. A moment later the massive iron door swung open, and Kegan was taken to the duke.

After the near-black corridors, with their slimy walls and stale air, the brilliance of the great hall was nearly overwhelming. MalMordha's entire court was assembled there in their finest attire, feasting and drinking to celebrate the nowsuccessful hunt. Kegan nearly lost the memory of that grisly slaughter as he contemplated the fabulous wealth he saw before him. Men and women dressed in the fairest silks, cloth of gold and silver. Gems sparkled like stars in the nighttime sky, scattering and reflecting the light of hundreds of scented candles. An irridescent ribbon flashed through the air, to light upon a perch set in the wall; the harpist recognized it as one of the variegated birds of the southern jungles. A second later more birds followed their companion's path, filling the very air with color. Along the walls hung tapestries, woven with patterns to please the eye, and placed to cut the chill night air. In the center of the room sat MalMordha. Seeing brought brought Kegan back to reality. The guard had given the duke his message, and now Kegan approached the high-backed chair, where sat the duke, and bowed to pay him homage. No acknowledgement was given; only a cold stare met Kegan's steady gaze. Several minutes passed thus, and the Fermanan was beginning to wonder if the duke were lost in some drug-spwaned dream, when at last MalMordha spoke.

"I am told you're a minstrel. Is this correct?"

"Yes, sire."

"And yet, 'minstrel'," and at the word 'minstrel' MalMordha's thin lips tightened into a sneer, "you have the look of a warrior, lean-faced, and tan. How is this?"

The last voice tittered to silence. Now all in the hall stared at Kegan, and waited to see how he would answer. Only the guards watched MalMordha, ready to act should his face judge the reply faulty. Kegan chose his words carefully, picking the right phrases as one picking footing across and ice-covered river of the North.

"Your pardon, sire, but I have come many a mile that I might sing before your court. Beneath the sun that burns the Kaleeshan desert I grew dark, and against the thieves that prey there I grew battle-honed. I beg thee, do not let my journey come to naught."

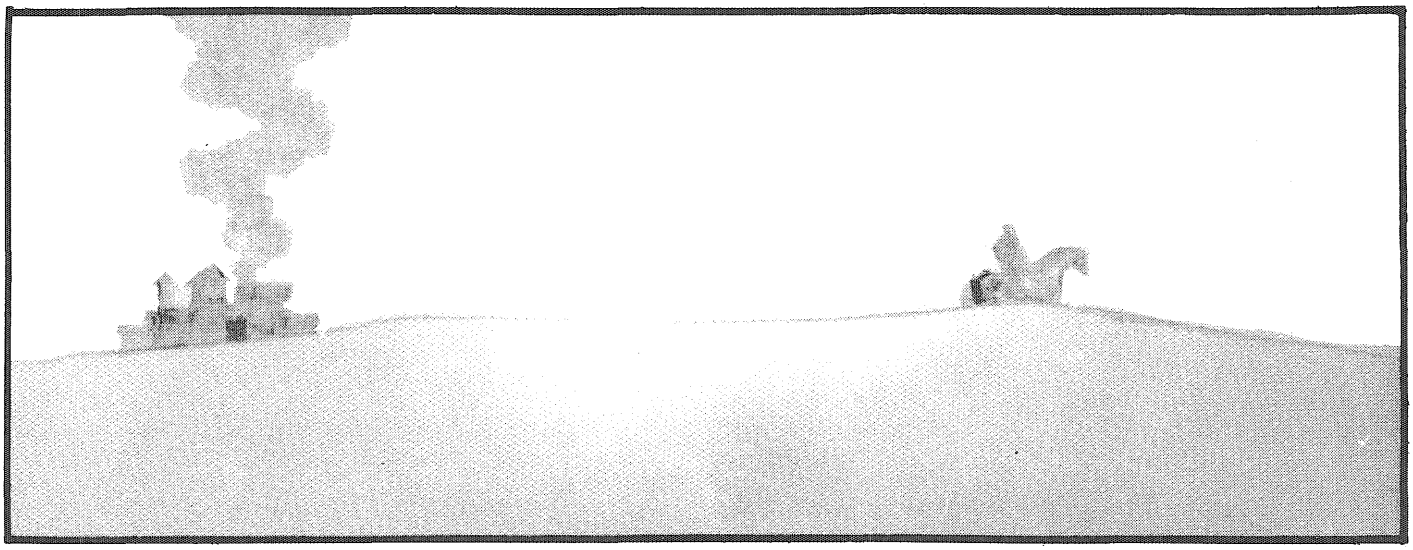
Before the echoes of his voice died in the hall Kegan knew he had laid to rest any suspicions MalMordha might have had. In the silence that remained the rustling of cloth as the mad prince stood resembled the wind that blows before the gale.

"By all means, then, you shall sing for us. But if your voice seem rough, or I can not hear you," an evil grin crossed his face, "you may practice on my rack."

A stool was brought for Kegan to sit upon, and he placed it in front of the dais, on the step but one below MalMordha's, calculating how far his voice would carry. Then, with another bow towards the duke, he seated himself, . crossing his legs to enfold and support the harp, which he lent against his left shoulder. This last had worried the harpist earlier, for it was the one fault in his disguise. Only the Fermanan harpists place their instrument on the feminine side, owing to the fact that it is constructed as a mirror image of the commomer type, with strings upon the left instead of right side. Were anyone present with a knowledge of music, or even an observant eye, they would immediately notice the difference, which might lead them to realize his race by way of his hands, which were now uncovered for playing. But there was no cry of recognition, no order to unmask. Still half-expecting discovery and subsequent death, Kegan struck a note in a bid for silence. The noise of feasting continued, with an occasional peal of drunken laughter ringing against the cold stone walls, to be swallowed up in the thick, fetid air. Only MalMordha was silent, smirking, openly mocking the young harpist. Now Kegan caught the meaning in the duke's last words.

The next moment the silver strings spoke, with all the sweetness of a woman's voice, the clarity of a temple bell. Sure, steady fingers moved slowly, plucking the wires to a crescendo, and then abruptly stopped. The revelers nearest had turned to inspect the source of such marvelous sounds. Quickly, before their attention waned, Kegan sang, and with him sang his father's harp.

The tales of many heroes were told, heroes of another time, and place, and even of another world, and in the now still hall there seemed to be two voices singing, perfectly matched, emanating from before the throne, hypnotic in the pattern of word and note. When Kegan sang of Beowulf in Grendel's lair, the painted women and jeweled men held in their breaths until the harp assured them of the triumph there. As the minstrel described the dragon slain by Cynric Arawn of far Othleen, a shiver ran down the silk covered back of many a nobleman there. Even MalMordha was among those who looked back over a suddenly chilled shoulder. And once, as the sputtering torches burned low, and the harpist told of how Brendican died, there came a high-pitched, wavering cry, as though the White Women, the spirits who lead dead warriors skyward, sang also. And no one inside the hall could say for sure that all they heard was only harp and bard.



And so the hours fled till Kegan judged the time was right. His voice fell silent, yet his fingers continued to play the strings. Now the tune he wrought was changed, yet the listeners noticed not. By only a few notes did it differ from those of the melody he strove to reach. Still, it was enough for failure. Then, at last, the song was reached. It left the harp like a thing alive, spreading throughout the hall like ripples spreading across a pond from where a stone dropped. Reaching the walls it corruscated against them, and back, to the harp from which it had sprung. Again it appeared, to diffuse once more, and this time returned more slowly, as though weighed down by some great burden. As it returned to the harp the strings seemed to twinkle with a brilliance brighter than the flames could give. Now Kegan could see the effects of his spell, for all across the room the courtiers' heads were nodding, showing the signs of drowsiness. Again the harpist sent forth the tune, to echo back heavier still. Like a weaver entwining warp and woof, so the bard wove souls and strings.

As Kegan cast his magic he sang a couterspell of Northern tune and Northern words, to keep himself safe from the harp's lure. So quietly did he sing that no one heard him chant but one, the one he meant to hear—MalMordha.

The harpist's eyes crept about the room, observing the courtiers. Not one among them moved, but stayed quite still, as though a master sculptor had come, affirmed his skill, and then moved on. Even the multi-colored birds which moments before had filled the air in riotous profusion now slumbered silently amidst the rafters of the high-ceilinged room. Only MalMordha was still conscious, lost in contemplation.

Abruptly, the music stopped. Before the duke could rouse himself from his musings the musician slid his hand into the sound box of the harp, to draw forth the dagger secreted within. Like a ray of sunlight it clove the air, burying its point in the back of the chair a hairsbreadth from MalMordha's throat. With a curse the duke whirled from his seat.

"Kill the dog!" Not a soldier moved, nor nobleman, nor lady. Kegan laughed at the bewildered look on his face.

"What manner of damned wizard be you, to steal my men this way?"

"I am death, MalMordha. Your death."

The glint of understanding entered the duke's eyes.

"Agoth take those merchants! What price do they pay,.assasin? I offer more to kill it."

The answer came in the sound of a sword being drawn from scabbard. Kegan approached with his borrowed sword, forcing the duke to likewise draw. The clang of steel rang out, and still the only movement in the room was of those two and the dancing flames in the firepit. MalMordha ran, and gained a momentary respite, for a table was between them. Kegan lunged across it, attempting to drive him away from the shelter. Catching a lampstand with his blade, the duke sent it crashing down upon the slab, showering his adversary with hot oil, and sending up a sheet of flame as the wick ignited the oil-soaked floor. Through this ran Kegan, vaulting the table to reach MalMordha. But the despot was gone. Kegan spun about in time to see the City's ruler topple his harp into the fire pit.

"May you join your harp and burn in Hell, wizard." And with a laugh he disappeared into the smoke.

Now commenced a deadly game of cat-and-mouse, where one mistake would end the play. The smoke was suddenly thicker, forcing duke and bard alike to grope their way about the room. Seeing a form looming out from the haze Kegan swung his broadsword full against it. The next instant he was sickened as a paralyzed noble toppled to the floor. Blood was nowhere to be seen, on the blade, or corpse, or floor.

Now came the stench of burning flesh, and twice a wisp of blue-grey clung to his face, stinging his eyes into blindness. Tears were blinked away seconds before MalMordha's sword would have dried them forever. Kegan backed away, brushing with his hand one of the tapestries that clung to the cold stone walls. When he drew away, a patch of wet darkness remained where he had been.

The harpist's mind stubbornly returned to the matter of the smoke. He wondered how there could be so much. The floor had ceased to burn; in the firepit his harp only began to smoulder. He glanced about the room seeking MalMordha. As he did, his gaze lit upon one of the courtiers his harp had stilled. The smoke swirled thicker there.

It was while he was pondering this that

he saw the duke glide from the smoke with an upraised hand. Silver flashed, and Kegan nearly failed avoiding the death that flew past. With a shock he recognized it as his own blade. Again laughter floated out from the mist. He melted into the gloom after it.

From out of nowhere appeared a sword's hilt, to slam against his head and send him reeling to the floor. As though he were a spectator at a play, he saw MalMordha approach, upraised sword in both hands. Lights flashed in his brain, appearing as pillars of flame in the ever thickening smoke. Kegan struggled to rise, but could do no more than kneel. He thought numbly how like a knighting his beheading was, but the expected blow never came. The duke paused in midstroke, his eyes riveted on something within the swirling smoke. A gurgle rose from his throat, his mouth twitched, but he said nothing. A look of abject terror spread across his face. Nearly blinded from the clubbing, his head throbbing, Kegan seized hold of his fallen sword. Shaking with the exertion, he straightened his legs, and half-lunging, half-falling, plunged his weapon into the duke.

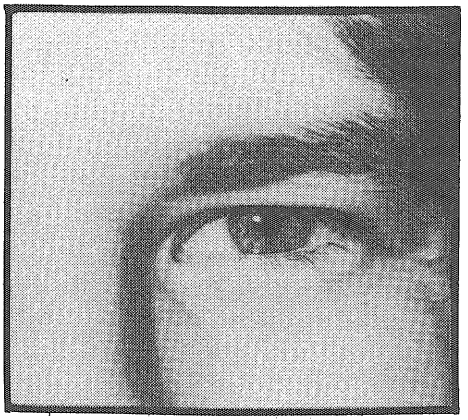
With a look of surprise, as though he'd seen Kegan for the first time, MalMordha tilted his head and let his gaze travel the length of the blade. Then on his face appeared recognition, and with it hate. And then both faded away, as Death clasped bony fingers to his erstwhile ally. That which had been MalMordha fell to the floor, wrenching the sword from the harpist grasp, leaving nothing but a great emptyness inside.

Then the sickening smell of burning hair and flesh assaulted Kegan's nose, and he looked up to a scene torn from Hell itself. Throughout the great hall of MalMordha stood his courtiers, clothed no longer in silk and jewels, but death. Nightmarish figures posed in bizarre attitudes while monstrous shadows danced on the walls. The hideous statues were enveloped by flames, writhing, living flames, that seemed possessed of demons' heads, consuming their unholy fare. Now the flames lept from the bodies to reach the tapestries, spreading the holocaust throughout the room.

Singly and in groups now, the flame-wrapped figures swayed, still silent as they crumpled to the floor. Through the smoke-filled room ran the harpist, seeking deliverance from Hell, blinded and choked by the clinging air. The last thing he would remember seeing would be his father's harp, it's silver strings bending, melting, forming little rivlets of liquid metal that flowed across the palace floor.

How he escaped that flame-shrouded room Kegan would never come to know. By some miracle he must have found an exit, and passed through corridors unnoticed. At length he found himself in cool night air. Behind him flames licked from the windows of the palace; about him swarmed the citizens, cheering the fire on, while above him shone the heavens' stars; before him lay the endless road.

The stranger paused in his journey north to slake his thirst at the well in the middle of the village. Across the plain of Kesh the last vestige of smoke had been dispersed by the rising wind. An ebullient villager was telling of the fire in the palace, of how even the stones were burned, and how the duke was found untouched by flames, but dead all the same, with a sword in the belly, and what did they think of that?



Socery, they answered; justice, said some.

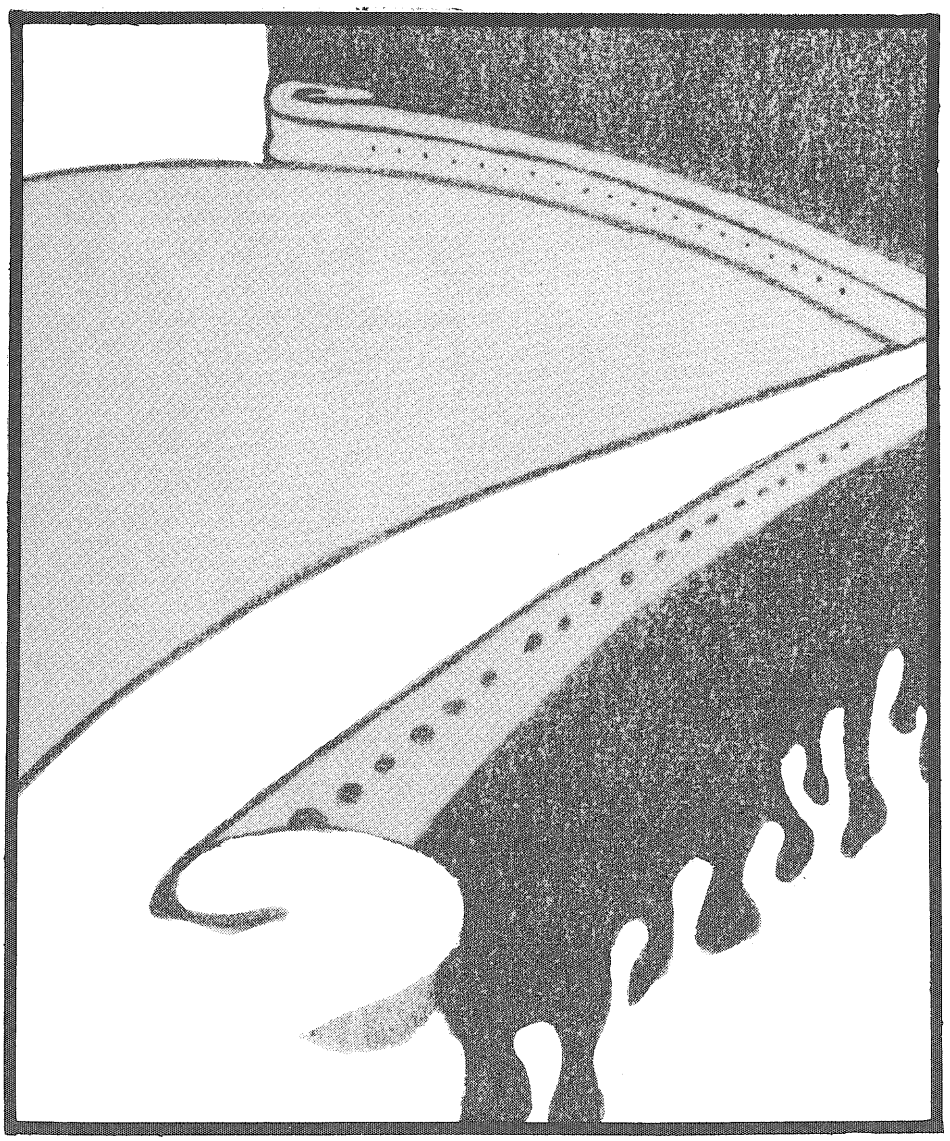
"Magic, I say," was the speaker's pronouncement. "What say you, stranger?"

The traveller looked up, his musings interrupted.

"There are tales..." he paused, remembering. "But I'm just a traveler, a musician of late," The stranger smiled tiredly, and wondered that he could smile at all, "what would I know of magic?"

But the villagers had already turned away, back to their gossip; the stranger turned to travel on. He left then, headed north, against the wind.

And floating back, upon the wind came a whistled tune that stung their ears, and chilled them deeper than any wind that ever blew, ever would, or ever could.



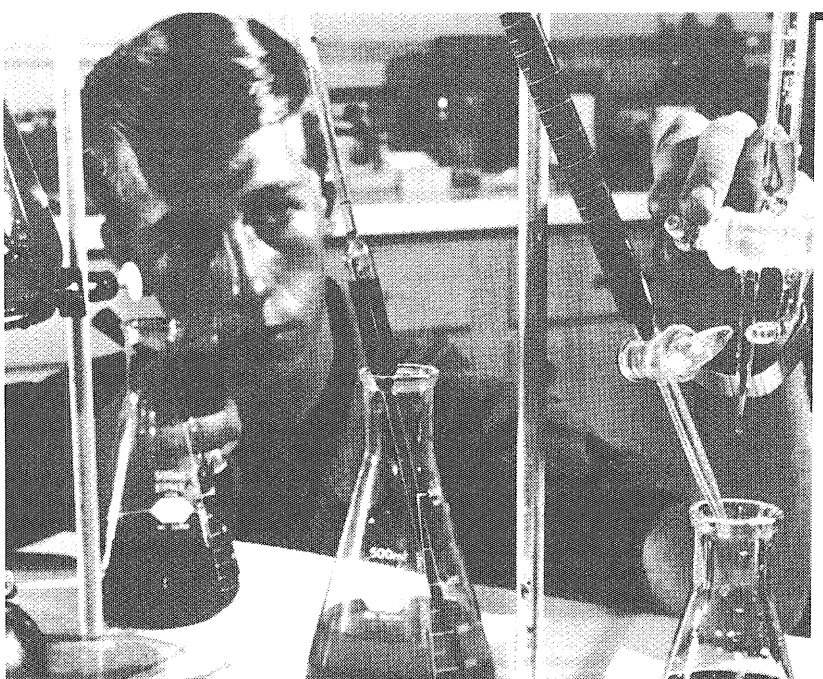
I.T. Things

Ag Engineers to dry corn with solar heat: Solar energy will be used as a supplemental source and as the only source of heat for drying corn in studies by the University of Minnesota, under a cooperative agreement with the US Department of Agriculture. The study is one of seven in the nation to determine the feasibility of using solar energy in drying corn. Use of solar energy as a heat source would, if practical, help conserve supplies of LP gas and other fuels now used in drying grain and would reduce costs. Minnesota agricultural engineers will use a solar collector as a supplemental source of heat for a batch-type grain dryer and as the only source for drying corn in storage. The studies will determine costs, rate, and uniformity of drying with solar heat and with unheated or low-heat drying.

Computer agency seeks volunteers: The Resource Access Center, operating under a grant from the Minneapolis Model Cities Program, is attempting to set up a data processing system to serve community agencies such as free clinics, co-ops, and tenants unions with services such as bookkeeping, survey processing, phototypesetting. The agency has acquired some used data processing equipment and needs engineering students with an interest in computers to perform volunteer work on the system. College credit is available. For more information contact Richard Koplow, 824-6406 or 529-9580.

Chem dept. offers research support: The Chemistry department is now taking applications from undergraduate students, preferably juniors, interested in a summer research program in chemistry. Those selected as Lando summer research fellows will receive $130 per week. Appointments beginning June 1975 normally run for 10 weeks. The program is supported by a bequest from Maximillian N. Lando, who received a bachelor of science degree in chemistry from the University in 1902. Deadline for application is Friday, February 28. Interested applicants should contact Professors Louis H. Pignolet or Donald G. Truhlar of the Chemistry department.

Student essay contest announced: Students from the University are invited to participate in the thrid annual powder metallurgy student essay contest sponsored by AO Smith— Inland, Inc. A $1000 first place prize will be awarded to a student on the merits of a 1000 word essay covering any aspect of ferrous powder metallurgy. Other awards include a $750 second prize, $500 thrid prize and $200 fourth, fifth and sixth prizes. Term papers, research project reports, theses or other papers from students' regular class work are acceptable entries. All entries must be postmarked by midnight April 1, 1975. Entry forms are available from the *Technolog*.



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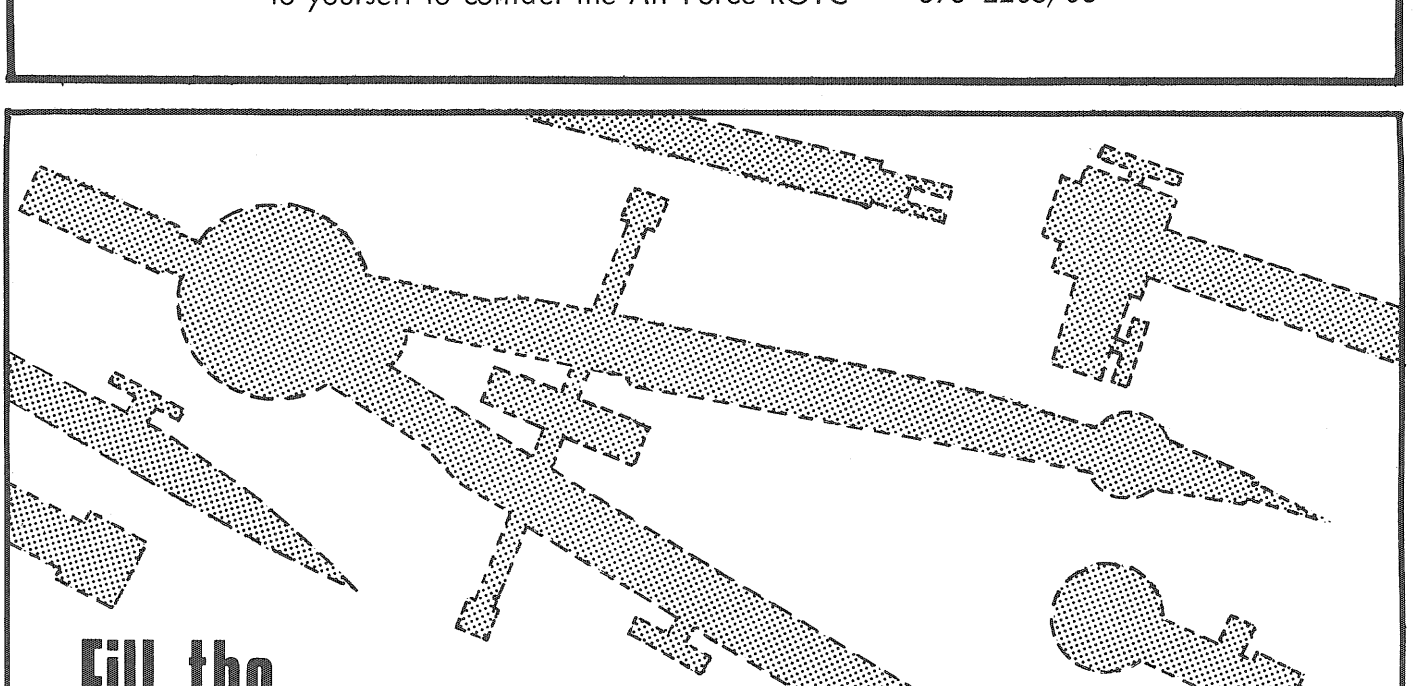

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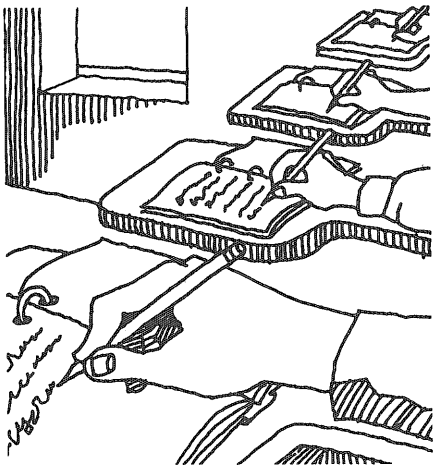

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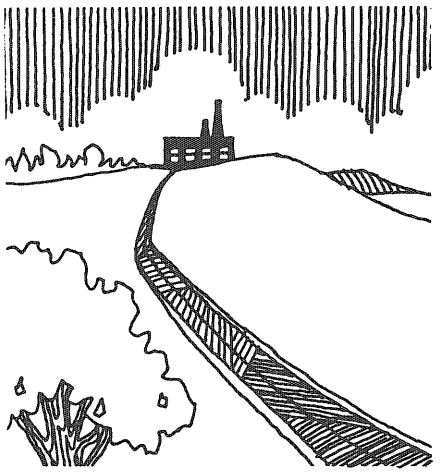

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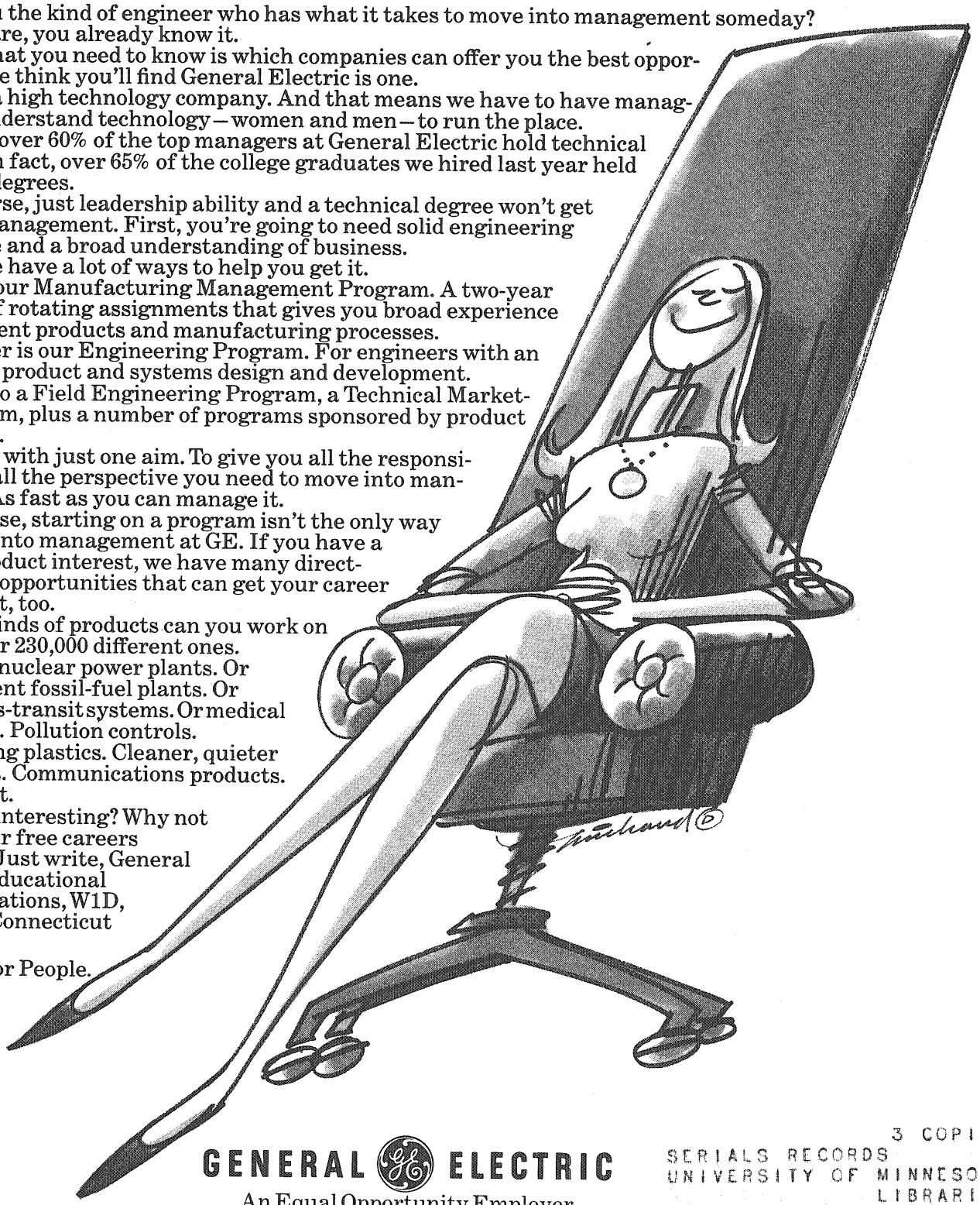

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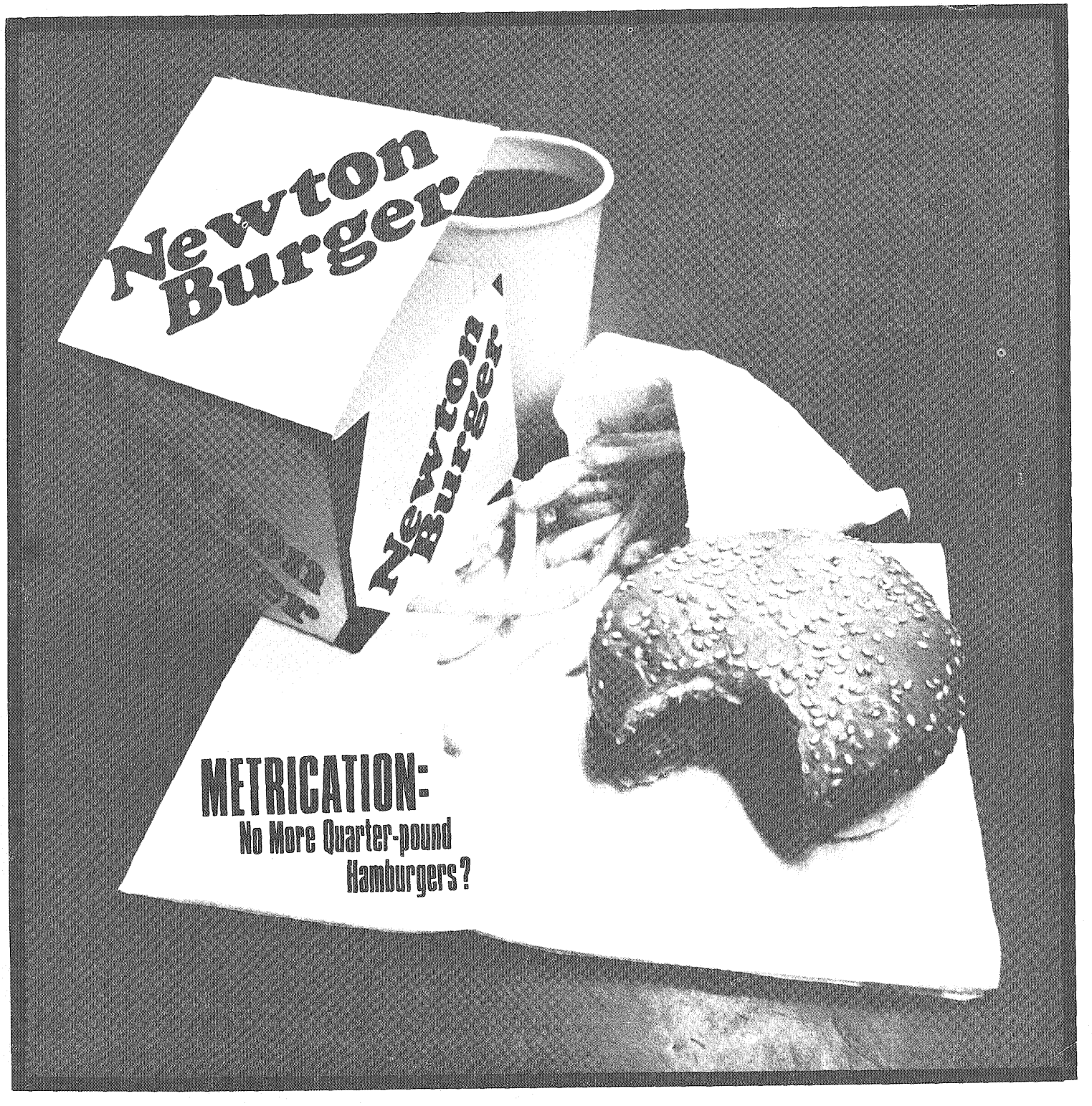

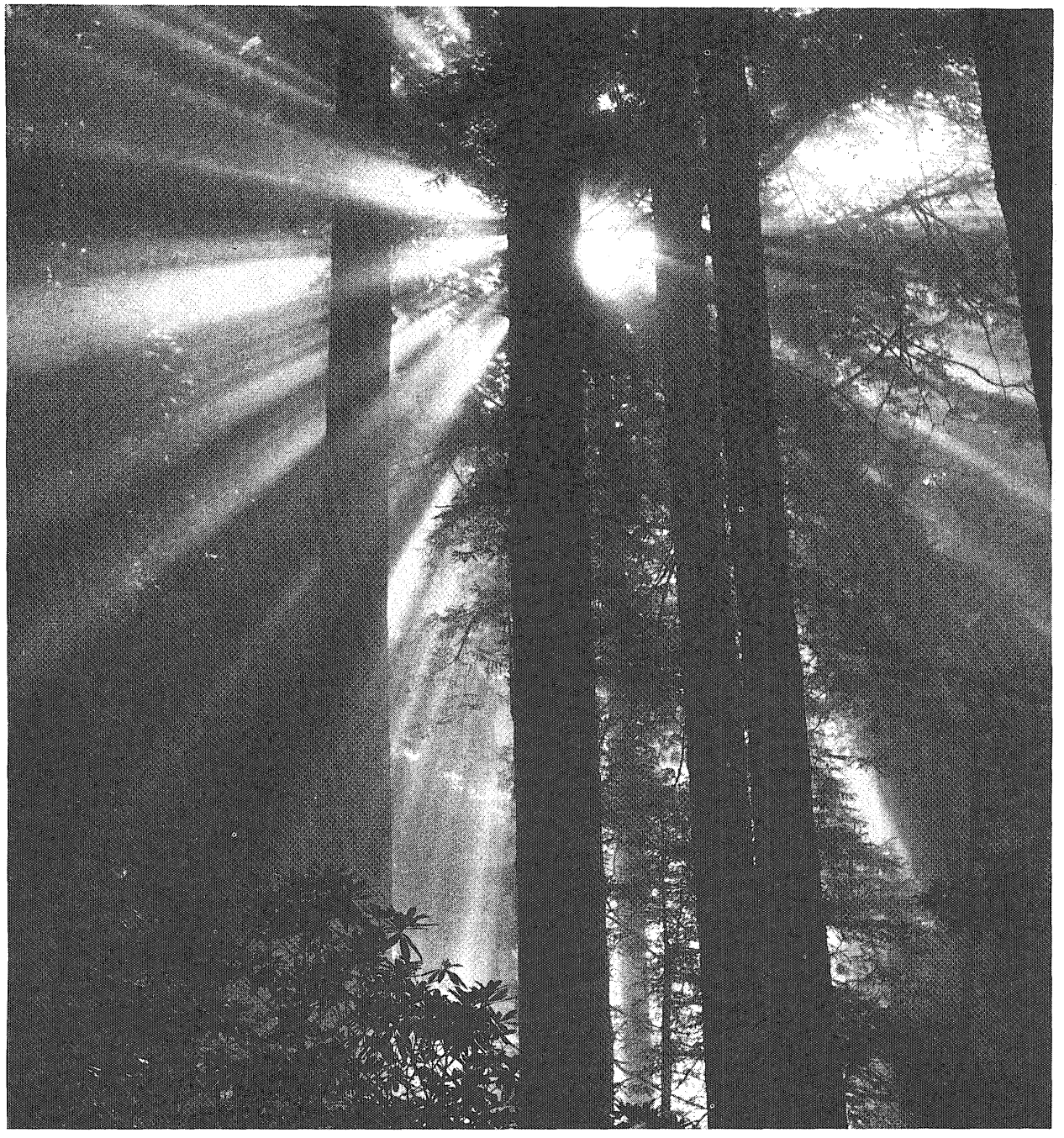

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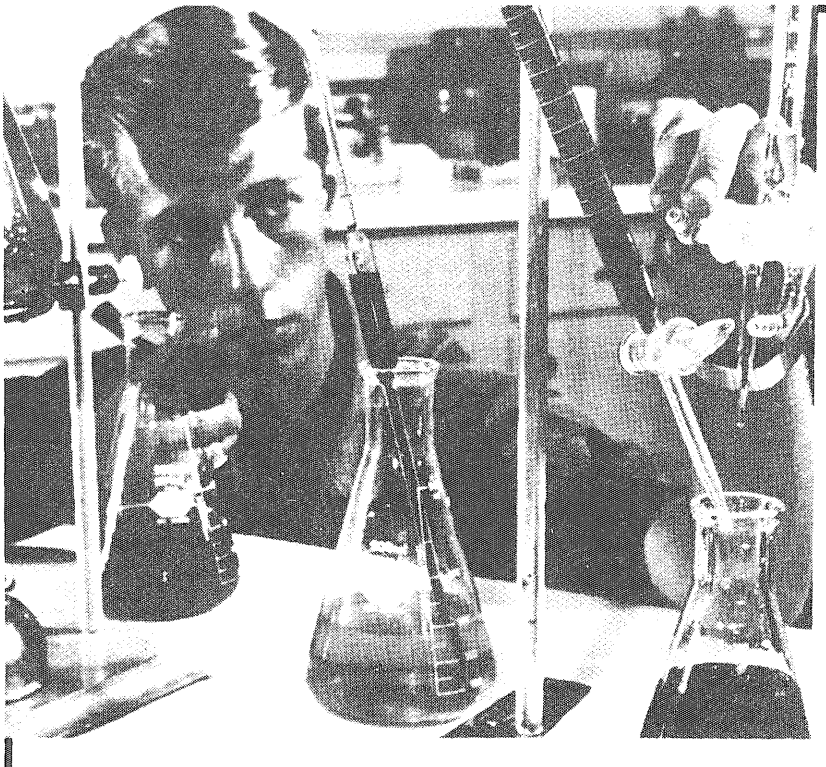

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Technolog editorial pages

The Decline And Near Miss Of Pat Pechacek

In case you have not noticed, the University almost lost its third student body president in three years, this month. The Student Assembly reached a tie vote on a motion to impeach its taciturn president, Pat Pechacek.

The Twin Cities Campus Assembly, some had thought, was making a habit of starting every year by dumping its president. Jack Baker began his second term of office, in the days when TCSA was spelled MSA, and discovered that he was done with Law School and did not qualify as a student. That did not seem very important to him, but it did to the MSA Forum and he was thrown prematurely into the practice of law.

The next year began with Steve Carter as president, elected by a firm majority that put his party in control of the Vice Presidency, the Forum and several college boards. By the time the Forum met in September, Carter had already spent most of the budget and found his party allies turning against him. Within a month he, too, was gone.

Pehacek thought he had learned from the mistakes of his predecessors. He spent plenty of time studying, maintaining his student status. And he did not spend any money he wasn't supposed to. He made sure not to do anything that would cause trouble. He did not, in fact, do anything. It is said that he went to one meeting between students and Governor Anderson and sat wordlessly through the meeting until the Governor pointed to him and said "aren't you from the Iron Range?"

When student leaders met with the Board of Regents, Pehacek did not show up at all. A delegation of students from Mankato waited for hours in the TCSA office for him to show up, but to no avail.

And so a motion was introduced to impeach Pehacek. Of the four I.T. representatives to the Assembly, Lynn Renz voted to impeach. Lowell Palacek, Wayne Petersen and Roxanne Goertz were more forgiving, and voted against the motion, which fell 15 votes short of the 2/3 majority needed to pass.

About the pie. The *Daily*, with a little forewarning, had three photographers on the scene when David Bland was hit with a faceful of shaving cream and chocolate fudge. We are told that charges of battery will be brought against certain individuals. That is, unless the *Daily* has already burned their unaltered negatives.

Violence is contageous. At least one calculus teacher has been given the pie-in-the-face treatment by his students. Rumors say that more student politicians, including an IT delegate, are scheduled to be hit in the future. It sounds like a lot more fun than streaking, even.

Back to politics. You will recall that the Assembly criticized Pehacek for not doing his job. It seems that as soon as the impeachment vote was taken, 11 representatives left immediately, leaving the Assembly's other business to the regulars. On normal days, the Assembly can hardly muster a quorum.

The IT Delegates claim that they have been present in person or by representative at all the Assembly meetings. We will deal with them later.

The official program for the fateful TCSA meeting. If you can spot a hammer & sicle, a cross and a phallic symbol, you win 10 points and a paper clip. Said one IT delegate: "It must have been done by a CLA student."

Don't ever say that student government is dull. Don't say that it makes sense either. Don't say anything, and you might find yourself impeached.

Introducing The Metric Lid

Dirty Pierre, the infamous "Canadian Connection" on the Minnesota dope scene, flew in from Montreal this week to tell us that the familiar lid of grass may soon be obsolete. "More and more progressive dealers", he says, "Are selling metric lids."

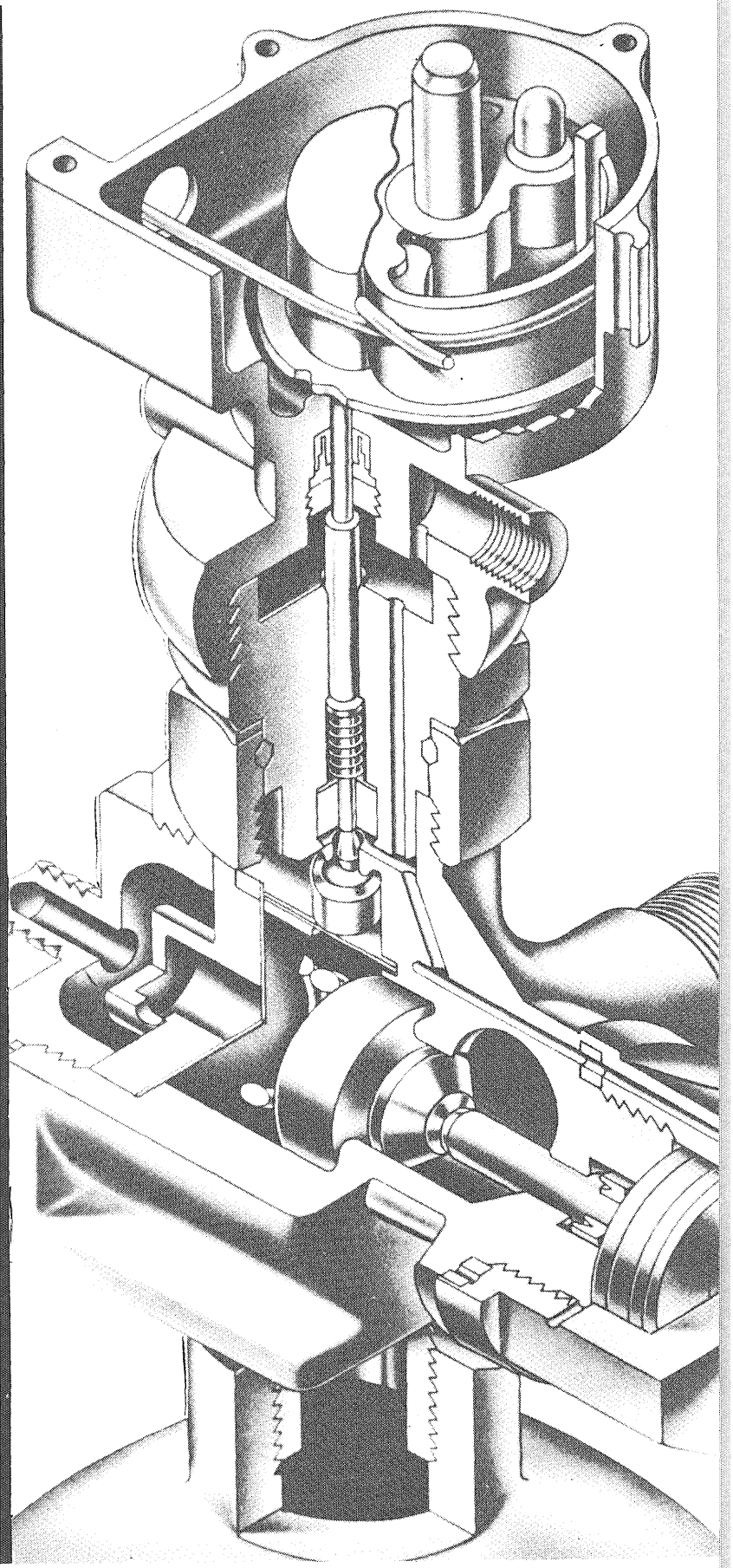
The metric lid, by international agreement, has a mass of 25 grams, 12% smaller than the customary lid. "It is not yet recognized by the Conference Generale des Poids et Measures", says Pierre in his rich French accent, 'but it is just a matter of time."

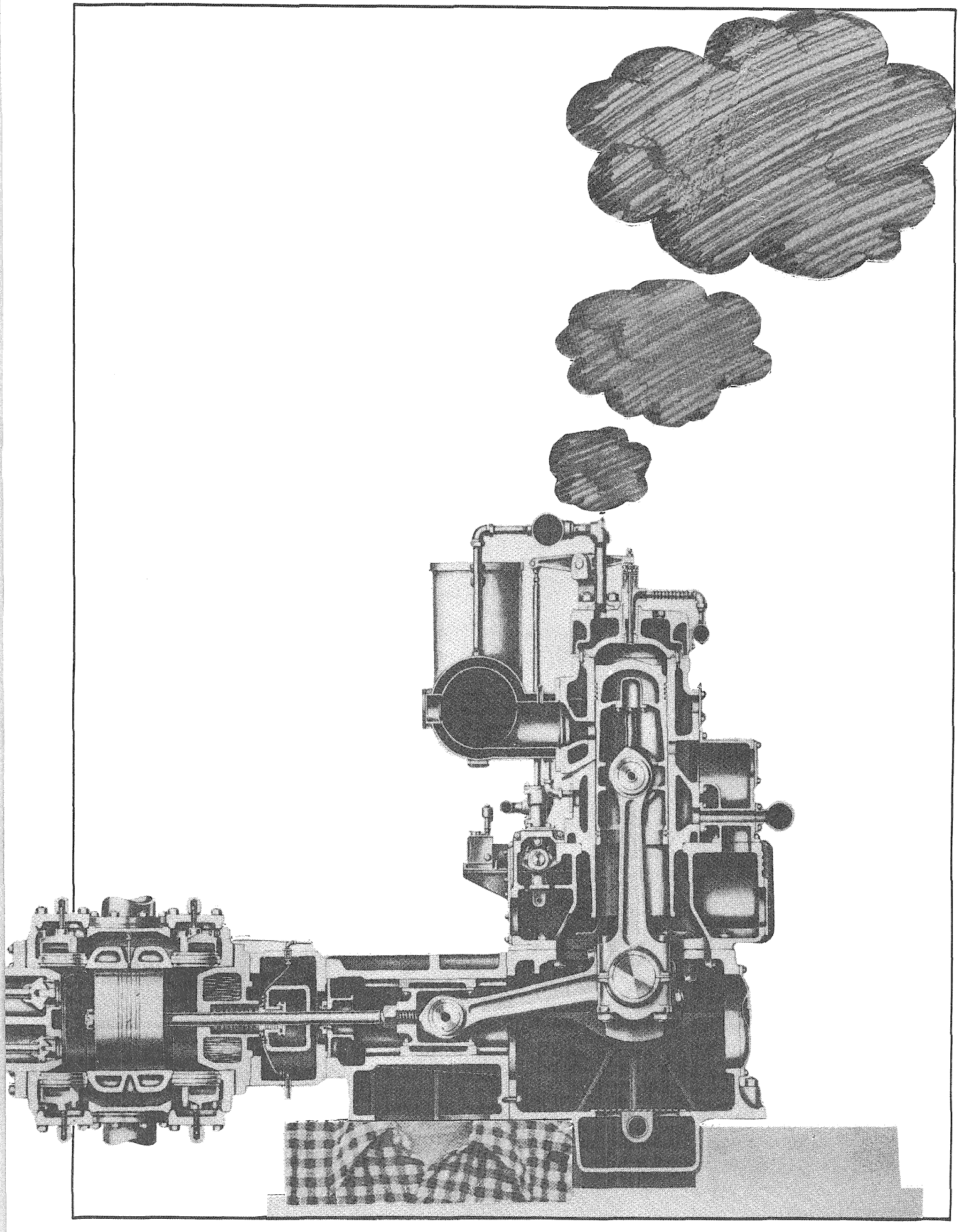
The new lid will solve a host of problems connected with the dope trade. For instance, if a kilo has 35.3 lids in it, what do you do with the .3? In the old days, you smoked it when you were done weighing out the merchandise. But with inflation and the profit squeeze, a dealer just cannot afford to do that any more.

With the new system, if the bags don't come out even, somebody's been smoking up the profits....

Another problem used to arise because most accurate balances were ripped off from Chemistry labs and were calibrated in metric units, and the dopers kept forgetting how many grams there were to a lid. Soon it will be easy to remember where to set the weights.

All in all, the change promises greater efficiency for dealers and customers alike. "We're doing our part", Pierre says, "to hold the line on costs and Whip Inflation Now."





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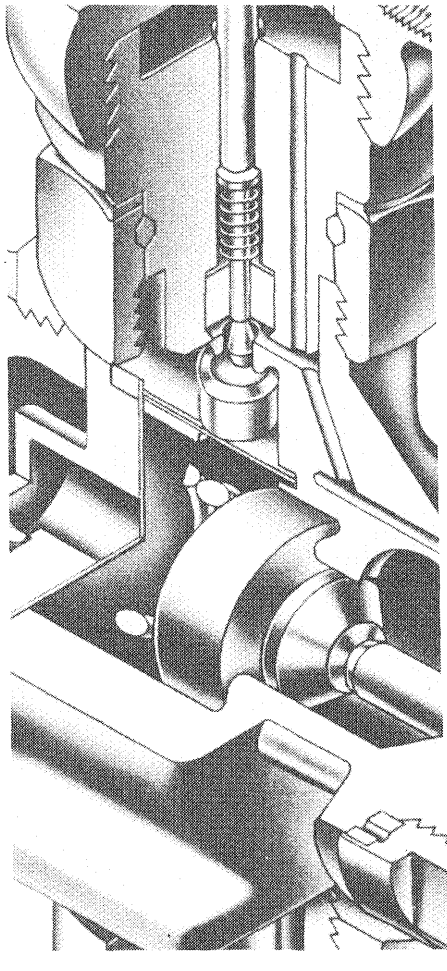

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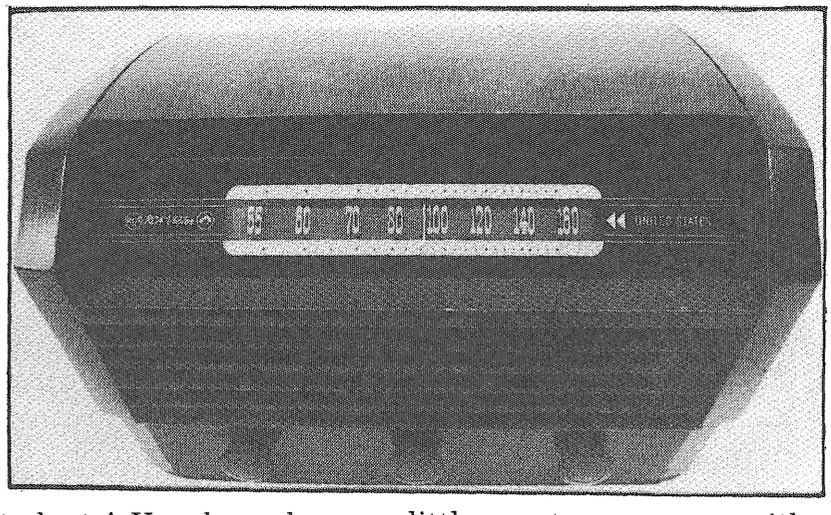
BIG TIME RADIO



IT students! You have been slandered! Not only has your intelligence been ridiculed, but your professional reputation and good name have been smeared by a source that is, in its own field, incompetent. This source is dull, offensive, professionally bankrupt and an insult to every University student who has any intellect or sensitivity to speak of. I refer to radio station WYOO, known in the vernacular as U100.

Maybe not all of you caught the ads they ran in a certain newspaper, showing a big quiz. If you know half the answers, they imply, you are long gone and a prime candidate to be a U100 listener. If you got 3 or less, they said, "You must be in 'I.T.'"

The ads, of course, ran in the *Daily*. But don't worry, there is more useful information in one paragraph of this article than in the entire Arts & Entertainment section of the *Daily*.

So what is this hot outfit that ran all the ads? WYOO is owned by a locally based conglomerate which also owns Litton Industries. The station began operation a little over two years ago with a format consisting of playing oldies-but-goodies. No contemporary music was played, with most of the records dating from the 1955-1970 era, with a few big band sounds thrown in.

Then they attempted a return to "personality radio" with such personalities as "the tall Robert Hall", "Sweet Michael O'Shea" and "the abominable Art Snow" (and he certainly was). Their version of big time radio contests included a free lunch at the Mariott Inn, giving away one whole oldies-but goodies album to the first caller whose name appeared on a certain telephone book page, and giving away one whole dollar per hour to the first caller at a given signal. WYOO was a first class outfit from the very beginning.

Later on, they amended their format to include big contemporary hits along with the oldies, but it was no use. By the summer of 1974, WYOO had arrived at the point of being in business nearly two years and had never, even once, been considered by advertisers as a major Twin Cities radio station. Landing a series of Perkins Cake & Steak ads was the high point of their commercial success. Even Coca-Cola wouldn't buy time from them, and Coke advertises everywhere except on the inside of manhole covers.

About the same time but across town, KDWB decided to go big time, and hired Buzz Bennett as their new program director. Bennett was a pro who was coming off another of his astounding successes. The last one was in New York City, where he took a struggling FM station, WPIX-FM, and won the top rating of any New York City station in the 18-34 age group. This was a feat equivalent to turning a stalk of asparagus into the Jolly Green Giant.

Bennett took one look at the KDWB staff and decided to clean house. Among the first to be axed was Rob Sherwood, the evening jock. Bennett did his job well. In three months "the new sound of KDWB" soared to number one ratings in virtually all time slots and age groups up to 34 years of age.

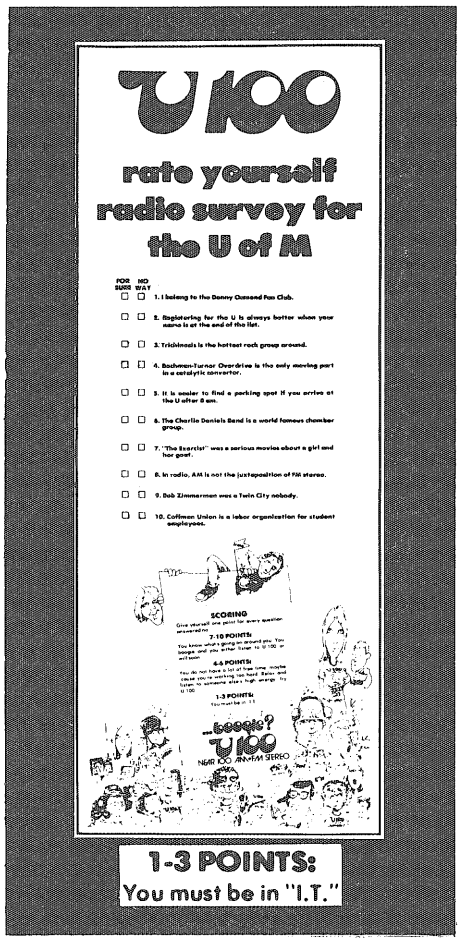
At the same time, WYOO made a move. They were apparently impressed with Rob Sherwood's record at KDWB, where every jock except for "the true Don Bleau" (who should be hitting 40 any day now) was the lowest rated in his time slot for an AM Twin Cities rock station. Being impressed by such ratings, which were still higher than their own, WYOO hired Sherwood.

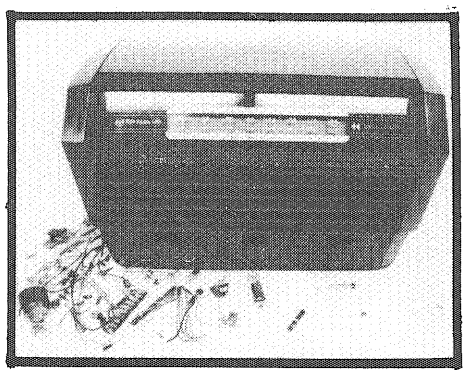
At the same time, KRSI-FM, dissatisfied with their ratings, switched to an automated, all-oldies-some-contemporary—music format. They saved a tremendous amount of money and took a majority of the WYOO audience away in the process. So, at WYOO, a major change was de-

creed. Continually impressed with the consistency shown by Sherwood in his ratings, they promoted him to program director. Under his guidance, the station switched to an all-boogie (whatever that means) format.

Program directors are a strange lot and an explanation of them and their work should be made here. A program director usually is a senior jock (but does not have to be—KDWB's Bennett is not an on-the-air personality) and his job is to come up with and maintain an overall station format. He hires and fires disc jockeys and announcers, decides what music is to be played and dictates overall station policy, including contests and advertisements. The Twin Cities, however, have a unique group of program directors. I honestly believe that to become a program director at a Twin Cities rock station, the first prerequisite is to be an all-around personal and/or professional failure. For example, Tack Hammer is the program director of KQRS. He took that job after successfully forcing KRSI through a half dozen "progressive" format changes, finally making it a country-western station. After KRSI-AM went hick, Hammer looked for new worlds to conquer. He found one at KQRS—they hired him as their new program director.

KQRS has never been a major Twin Cities radio station and is virtually non-existent outside the University community. Hammer has done nothing to upset this long standing tradition. For his station jocks, Hammer uses stiffs who come wandering in off the streets, and he still uses that famous progressive programming technique of (1) closing your eyes, (2) grabbing any record within reach and (3) dropping the needle down anywhere you want





to, thus deciding what gets airplay on KQRS. No wonder you have to use a magnifying glass to read their ratings.

Johnny Canton, the 10:00 to 1:00 jock is the program director at WDGY. Under his direction, WEEDGEE used to pull such tricks as the old "legal payola" bit. This was legal because at regular intervals, usually 2:00am, they would make a public announcement that "certain records are played in consideration of certain record manufacturers....." or something like that. In other words, they were paid by the record companies to play certain disks. The FCC finally put a stop to that. Nowadays, WDGY speeds up their records, turning the 45's at 50 or so rpm. When they claim to play "95% music this hour on WDGY", the "music" includes commercial jingles and the standard time duration of the records.

Chuck Knapp is the program director at KSTP. Knapp arrived in the Twin Cities after being a bomb in Boston, where he was working the 6-10 pm slot as "Chuck Chuckles Knapp—your LEEEDAAA baby!" who was "popping the top on the new, round sound for you!" It was great stuff. He must have written his material himself. After he was bounced there, he latched onto WCFL, Chicago, where he also bombed. Then he was picked up by KSTP, when they changed their format to "15 KSTP, the music station", and he did the early morning slot with his "rhymin' time newsman, Charlie Bush." When Jim Garrett left KSTP, Knapp, who was relishing his borderline success as a morning man, was somehow promoted to program director.

Knapp can't be all bad, though. At least he had the sense to axe Tom "The Cat Man" Bernard, the first official graduate of the Steve Shannon School for Obnoxious Deejays (with Dr. Brock as a visiting faculty member). Of course, Johnny Canton showed what a turkey he really is—he hired Bernard to do the 6-10 pm slot for WDGY. By the way, if you need a job, just make a demonstration tape and apply to Canton for that WDGY 6-10 pm slot. Last year alone they used Boob-Boob Bailey, Mark Andrews, GT Stone

and Eric Edwards in that slot, all with minimal success. And if Canton gave that job to "The Cat Man" Tom Bernard, even as a joke, then anybody (and I mean *anybody*) can do it.

When Rob Sherwood was made program director of WYOO, he decided to keep only those jocks who reminded him of himself, so he kept only the losers. He retained Jerry Brooke, who became JEROLD (or JEROME—it's tough to tell when the voice is as clear as Skip Loescher's) and kept "the tall Robert Hall" who became "Brother Bob." Brooke was a reject from WIXY in Cleveland where he was best known for having invented "the Brookeburger—two records played back to back!!" Hall was a reject from WLOL, which should tell you enough about him. Sherwood also brought in Jeff "Mutha" Robbins, a fellow KDWB reject (funny, how that word—reject—keeps popping up when discussing WYOO disc jockeys) along with Captain Billy and Michael J. Douglas to do a pathetic imitation of KSTP's Chuck Knapp and Charlie Bush early morning offering. Either show is a rude awakening.

Sherwood decided to call the station U100 since YOO can be pronounced 'U" (in the same way that WDGY can be pronounced WEEDGEE) and the 100 comes from its approximate spot on the dial. This is not a new idea. WXLO-FM in New York City refers to itself as "99X" and KDKA in Pittsburgh calls itself "13K."

Sherwood did slip up once, though. He hired a jock named US Steele to do a late evening show. Steele has a rather gruff voice but he is pleasant, easy to listen to, unobnoxious, and seems to be able to think on the air (i.e. keep his foot out of his mouth). I do not know why Sherwood hired him. Steele obviously does not fit into the overall image of U100 and certainly does not belong on their staff.

Jeff "Mutha" Robbins also deserves a few small kudos. He has guts, as he once said "I'll take down my pants and shit on a rock" on the air, although he said it so fast that he could explain it away if the FCC called him on it. Also, Robbins has some intelligence and uses it so that his obnoxious act comes across as actually being clever. In other words, he picks his spots rather than trying to drown his listeners with words, like Brother Bob and Rob Sherwood do.

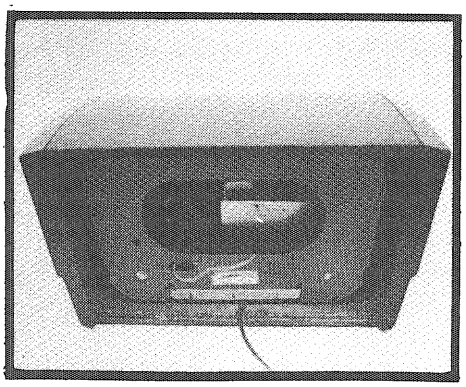
Captain Billy, in the early morning, and Brooke in the late morning, do not rate coverage here. Billy is so pathetic that he could not enter one of his shows in a sunday school amateur talent contest. Brooke is supposed to be a pro, although you would never know it after listening to his show.

Brother Bob does the 12-3 pm shift. As "the tall Robert Hall" he would dispense such idiotic, barefaced lies as "Alice Cooper is actually Billy Grey, who used to star in 'Father Knows Best.'" Then he became "Brother Bob on the SOOOPAA YOUUU!!" Brother Bob is the kind of guy that needs to dry-run a 10 second public service announcement seven times before he is willing to trust himslef on the air with it. But the king of this crew is Sherwood, who does the late afternoon spot.

Rob Sherwood is the clown prince of U100. He really does get turned on by the sound of his own voice as he constantly cuts records short so that he can yell about some nonsense or go into one of his long, rambling monologues which defy comprehension. Sherwood thinks

Technolog rate yourself radio survey

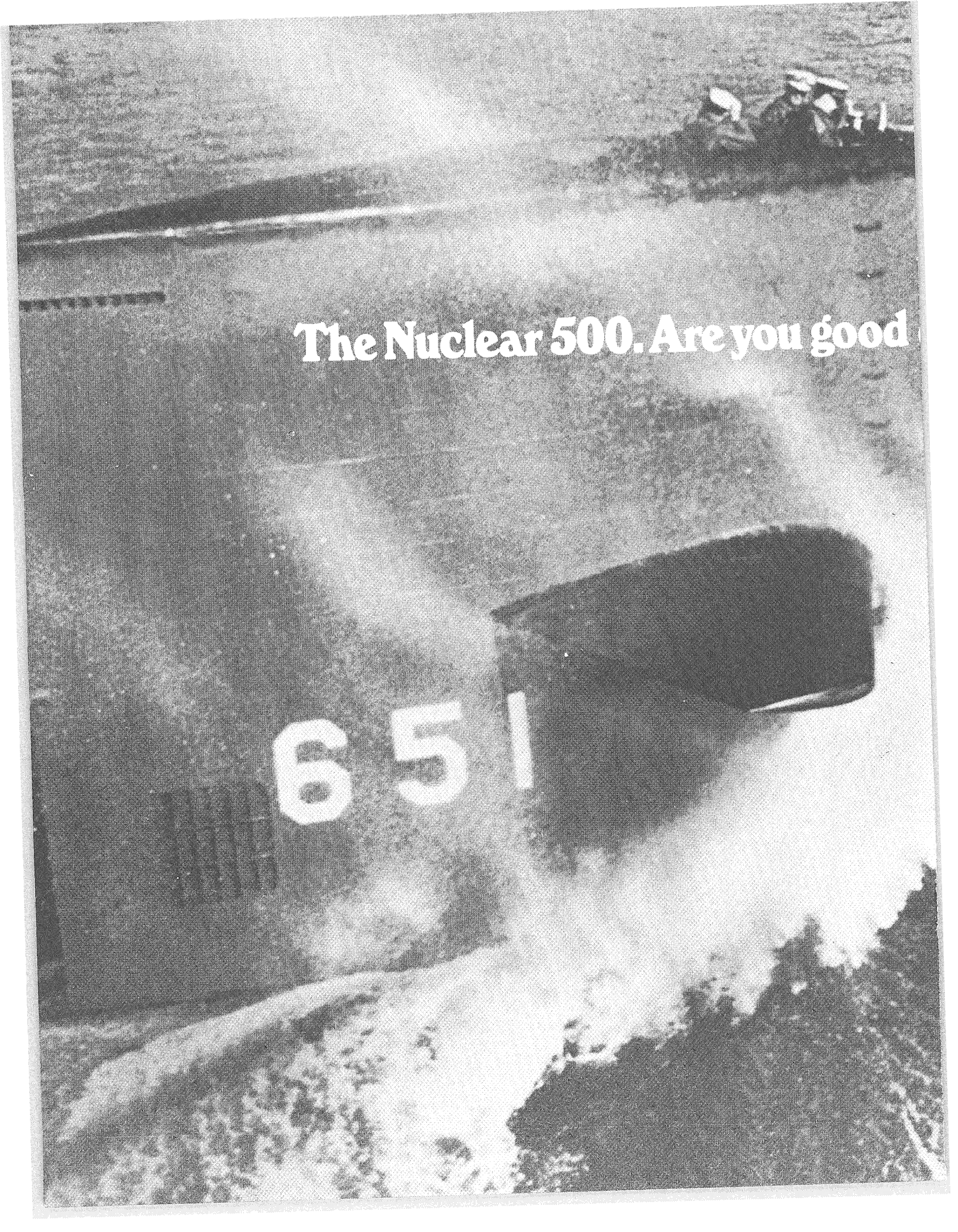
FOR SURE	NO WAY	
☐	☐	I can actually listen to U100 when I'm not stoned.
☐	☐	U100 would be a better station if they played "Kung Fu Fighting" more often.
☐	☐	Captain Billy actually has some talent.
☐	☐	U100 is actually the name of a famous German submarine.
☐	☐	Brother Bob has never filed his tongue with an emery board.
☐	☐	"Oh Mary" is an example of subtle variation from one verse to the next.
☐	☐	U100 would be more popular if they broadcast on the police/fire band instead of FM.
☐	☐	The Minnesota Daily gives detailed, incisive reporting.
☐	☐	U100 listeners average a mental age over seven years.
☐	☐	I belong to the Rob Sherwood fan club.



that it is cool to gross out public service announcements, hassle girls who call him up and has discovered that the word NUDE, when spoken over the air, grabs a listener's attention. So Sherwood makes sure he uses it at least once every 15 minutes.

Apparently Sherwood thinks he is one of the few "personalities" in Twin Cities radio. In that assumption he may be correct but if the personality is that of a silverfish and you have a voice that sounds like a rock crusher, then you really ought to keep it to yourself.

All things considered, maybe U100 did IT a favor. To be a U100 listener, you obviously must be easily impressed, uninformed and love 13-year old teeny-bopper music. U100 listeners probably think that Harry Chapin's "Cats in the Cradle' is the heaviest song of all time. The *Daily* staff probably disagrees with them. They would probably choose "Seasons in the Sun" or "I Shot the Sheriff" or "Rock the Boat." □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Metric America as simple as it sounds?

In late 1971, Senator RP Griffith expressed his concern that America was losing business abroad because nobody could understand our system of measurement:

> If American machine tools do not fit foreign machines, if American screws do not fit foreign holes, and if American standards do not fit foreign specifications, the industrialization of the rest of the world is bound to be at the expense of American industry and labor.

His answer to the problem was that the US adopt the Metric System, a simple decimal scheme of meters, grams and liters.

But is it that easy? For engineers, it isn't. The engineer who has discarded his ruler in favor of a meter stick is still faced with a choice of five "metric" systems, dozens of obsolete "metric" units, several standard setting systems, and a variety of "metric" standard sizes.

When the US finally commits itself to the Metric System, the most critical phase for engineers will begin—when we choose whether to go from an English muddle to a Metric muddle, or from chaos to order.

In the following pages, the *Technolog* presents a guide to the Metric System, to its most popular variant, the so-called "Systeme Internationale" or SI, and to Metric standard-setting. Read on!

FIVE METRIC SYSTEMS
An alphabet of choices

The metric system adopted in France in 1795 consisted of only three units, the meter, liter and gram. All three units were interrelated—the liter was a volume of $E-3$ meter^3 and the gram, the mass of $E-3$ liter of water.

MGS System: In 1863 Sir William Thomson, Lord Kelvin, proposed the MGS system based on a meter, gram and second. It represented the first attempt to derive further units from the original basic units, and to devise a comprehensive rationalized system. The system was formalized by the British Association for the Advancement of Science.

CGS System: In 1873 the Association decided to replace the meter in MGS with a centimeter, producing the CGS system. This could be considered a backward step, but it has had longlasting effects. It has popularity among scientists who work with small quantities. In fluids studies the centipoise and centistoke are commonly used CGS units. In electromagnetics, the gauss and maxwell are popular CGS units since they often lead to unity constants.

MKS and MKSA: Professor Giovanni Giorgi of Italy suggested the MKS system based on the meter, kilogram and second in 1901. He later proposed a base electrical unit, the Ampere, to be added to the MKS system, producing the MKSA system.

MTS: The system based on the meter, second and metric ton was instituted by law in France in 1919 and for 42 years was the basis of the French legal system of measures. MTS had certain advantages for use in commerce, but it has never become known outside of France.

SI: A form of the MKSA system was approved in 1954 by the Conference Generale des Poids et Measures, an international organization. The system included, for the first time, the Candela and Kelvin. In 1960 this system, consisting of six fundamental units, two supplementary units and numerous derived units was named SI after the internationally current abbreviation of the French "Le Systeme Internationale d'Unites." A seventh base unit, the mole, is under consideration. SI has been adopted by over 17 countries, including West Germany, Japan and the USSR.

THE CASE OF THE GRAM- CENTIMETER
The Russians do it again

I quivered with excietment as I

opened the service manual to my Uher tape recorder (the special Rose Mary Woods model). Knowing that it was from Germany I was prepared for metric units. But the first instruction I came across said, "Adjust the reel torque to 150 gram-centimeters."

"Gram-centimeters!" I exclaimed. A quick check of my engineering class notes confirmed that the unit for torque is a force times a length. So why is Uher trying to tell me to torque something to a quantity that doesn't exist?

Some further investigation led to the following discoveries:

First, most torque meters for repairing mechanical devices are marked in gram-centimeters. Secondly, it is common in Europe to use a gram-force and gram-mass unit in similar fashion to our pound-force and pound-mass units. In a recent *Science News*, Russian measurements of the surface pressure on Venus were reported in kg/m^2, resulting in a flood of letters demanding that the Russians be reprimanded for violating the SI rules that they had adopted by international agreement.

The incident might not be important enough to call on Henry Kissinger, but it shows that even the Europeans will have to convert to a strict SI system if we are to have a rationalized and coherent system of international units. The kilogram-force and kilogram-mass units may sound metric, but they are no more rational than the English units.

THE NEW METRIC SYSTEM: SI

The most widely accepted metric system is the "Systeme Internationale" or SI. The system has a set of six standard base units, two supplementary units and a coherent set of derived units. Its rules even dictate how the units are to be written out.

The system is designed to possess the three important virtues of measuring units:

Coherence: All derived units are obtained by the direct multiplication or division of the base units. Thus the Joule is a Newton-meter or a kilogram-meter^2/second^2.

Absoluteness: Measures are derived *only* from the base units, without reference to arbitrary constants. Thus temperature is measured in Kelvin, without reference to the arbitrary zero of the Celsius and Fahrenheit scales. Mass is measured in kilograms, in contrast to the English slug, which is related to the pound-mass by the acceleration of gravity.

Uniqueness: There is only one quantity or term used to measure each physical characteristic, and it is expressed in only one unit. The Joule is used for all forms of energy, work and heat, while the Watt is used to express all forms of power, whether mechanical, electrical, thermal, chemical or nuclear.

THE SI UNITS

SI includes the meter, kilogram and second of the MKS system as fundamental units, plus the ampere, kelvin and candela, all defined as shown in table 1 . The mathematical quantities radian and steradian are included as supplementary units. Another

Definitions of the basic SI units

Metre: The metre is the length equal to 1 650 763.73 wavelengths in vacuum of the radiation corresponding to the transition between the levels $2p_{10}$ and $5d_5$ of the krypton-86 atom.

Kilogramme: The kilogramme is the unit of mass; it is equal to the mass of the international prototype of the kilogramme.

Second: The second is the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium-133 atom.

Ampere: The ampere is that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross-section, and placed 1 metre apart in vacuum, would produce between these conductors a force equal to 2×10^{-7} newton per metre of length.

Kelvin: The kelvin, unit of thermodynamic temperature, is the fraction 1/273.16 of the thermodynamic temperature of the triple point of water.[1]

Candela: The candela is the luminous intensity, in the perpendicular direction, of a surface of 1/600 000 square metre of a black body at the temperature of freezing platinum under a pressure of 101 325 newtons per square metre.

Mole: The mole is the amount of substance of a system which contains as many elementary units as there are carbon atoms in 0.012 kilogramme of carbon-12. The elementary unit must be specified and may be an atom, a molecule, an ion, an electron, a photon, etc., or a specified group of such entities.

[1] In October 1967 the thirteenth Conférence Générale des Poids et Mesures recommended that the kelvin, symbol K, be used both for thermodynamic temperature and for thermodynamic temperature interval, and that the unit-symbols °K and deg be abandoned. In accordance with this recommendation the symbol K has been used throughout this Report.

base unit, the mole, is gaining acceptance.

Numerous derived units have been sanctioned. A few of those important to engineers and scientists are listed as follows:

Frequency: unit, hertz. symbol, Hz. The hertz is the frequency of a periodic event of one cycle per second. In South Africa, the hertz is used for rotational frequency. This has not been introduced elsewhere, but there is nothing in the definition that would preclude it. For example, a 2400 rpm motor could be described as a 40 Hz motor. It is much easier to visualize a rotation of 40 Hz than 2400 rpm. The brief second is more meaningful than the minute, which is unacceptable in SI.

Care must be taken to distinguish between rotational frequency and angular frequency, which is in radians per second. The radian is a supplementary unit in SI.

Velocity: unit, meter per second. symbol, m/s. Some European authorities have suggested that speed limits be expressed in meters per second rather than in kilometers per hour. The hour is contrary to SI rules, making kilometers per hour an unacceptable unit.

Acceleration: unit, meter per second per second. symbol, m/s^2. The meter per second per second is the acceleration of an object moving on a linear path at a velocity which in one second increases at a uniform rate of one meter per second.

Force: unit, newton. symbol, N. The newton is that force which when applied to a body having a mass of one kilogram gives it an acceleration of one meter per second per second.

The newton will replace four obsolete metric units and eight non-coherent English units. The technical metric units kilogram-force and gram-force are sometimes erroneously referred to as kilogram and gram. Likewise a distinction is not alwyas made between pound force and pound mass. Future use of the newton will prevent any such confusion with units of mass. This could be done without uprooting the popular use of the word *weight*.

Names and symbols for basic SI units

Physical quantity	Name of SI unit	Symbol for SI unit
length	metre	m
mass	kilogramme	kg
time	second	s
electric current	ampere	A
thermodynamic temperature	kelvin	K
luminous intensity	candela	cd
amount of substance	mole	mol

Names and symbols for supplementary units

These units are dimensionless.

Physical quantity	Name of SI unit	Symbol for SI unit
plane angle	radian	rad
solid angle	steradian	sr

Pressure: unit, pascal. symbol, Pa. The pascal is the pressure exerted by a force of one newton evenly distributed over an area of one square meter. This unit was from 1960 to 1971 officially known as the newton per square meter, although the name *pascal* has been used in France for many years. It was made a part of SI in 1971.

The pascal has been the most difficult unit to introduce in metric countries where professionals are stubbornly attached to officially obsolete technical metric units. The French MTS system based on the metric ton and second has the pressure unit *pieze* which is larger and better suited to common measurements.

Another alternative to the pascal is the *bar* (from the Greek word *baros*, weight). It was originally in the CGS system and equals E6 dynes per square centimeter. Despite objections that the bar is not a legitimate SI unit, it is being introduced into many countries, including Great Britain and South Africa. It is retained in many traditionally metric countries, and is preferred

Other units now exactly defined in terms of the SI units

These units are not part of the SI. It is recognized that their use may be continued for some time but it is recommended that except in special circumstances they should be progressively abandoned in conformity with international recommendations. The following list is by no means exhaustive. Each of the definitions given in the fourth column is *exact*.

Physical quantity	Name of unit	Symbol for unit	Definition of unit
length	inch	in	2.54×10^{-2} m
mass	pound (avoirdupois)	lb	0.453 592 37 kg
force	kilogramme-force	kgf	9.806 65 N
pressure	atmosphere	atm	101 325 N m^{-2}
pressure	torr	Torr	(101 325/760) N m^{-2}
pressure	conventional millimetre of mercury [1]	mmHg	13.5951 × 980.665 × 10^{-2} N m^{-2}

Special names and symbols for derived SI units

Physical quantity	Name of SI unit	Symbol for SI unit	Definition of SI unit
energy	joule	J	$kg\,m^2\,s^{-2}$
force	newton	N	$kg\,m\,s^{-2} = J\,m^{-1}$
power	watt	W	$kg\,m^2\,s^{-3} = J\,s^{-1}$
electric charge	coulomb	C	$A\,s$
electric potential difference	volt	V	$kg\,m^2\,s^{-3}\,A^{-1} = J\,A^{-1}\,s^{-1}$
electric resistance	ohm	Ω	$kg\,m^2\,s^{-3}\,A^{-2} = V\,A^{-1}$
electric capacitance	farad	F	$A^2\,s^4\,kg^{-1}\,m^{-2} = A\,s\,V^{-1}$
magnetic flux	weber	Wb	$kg\,m^2\,s^{-2}\,A^{-1} = V\,s$
inductance	henry	H	$kg\,m^2\,s^{-2}\,A^{-2} = V\,A^{-1}\,s$
magnetic flux density	tesla	T	$kg\,s^{-2}\,A^{-1} = V\,s\,m^{-2}$
luminous flux	lumen	lm	$cd\,sr$
illumination	lux	lx	$cd\,sr\,m^{-2}$
frequency	hertz	Hz	s^{-1}

in Finland chiefly because of linguistic problems in pronouncing "pascal." One bar is close to atmospheric pressure.

The hectobar is favored for pressures and stresses in the construction industry and is used by French mechanical engineers. The millibar is used internationally to measure atmospheric pressure. Since millimeters of mercury (mm Hg) is on the way out, the millibar may be used for blood pressure measurement rather than the kilopascal.

The pascal and bar will replace 28 different pressure units in use of which 11 are obsolete metric units, 10 are English units and 7 are hydrostatic units.

Energy: unit, joule. symbol, J. The joule is the work done when the point of application of a force of one newton is displaced a distance of one meter in the direction of the force.

Although the joule is not as small as the erg, it is another SI unit that is impractically small. The joule is even smaller than the obsolete *calorie*. A reducing diet of four megajoules per day might sound generous, but most people would exceed that limit at lunch.

Coupled with the prefixes kilo- and mega-, the joule will replace 32 energy units in use, 16 of which are obsolete metric units (including five different calories) and 11 non-coherent English units (five of them different BTU's) and five scientific units.

Although the calorie is gone for good, there are unfortunate signs that the kilowatt-hour will remain despite the fact that it is not metric or even decimal.

Power: unit, watt. symbol, W. The watt is the power which gives rise to the production of energy at the rate of one joule per second. In North America, the watt has only been applied to electrical power. Under SI all forms of power will be in watts. The watt will replace 20 different conventional units including five kinds of horsepower, various BTU and foot-pound-force per hour and per second units, calories per second, kilogram-force meter per second, tons of refrigeration and others. This will amount to an extensive rationalization enabling comparisons to be made without complicated calculations.

Electric potential: unit, volt. symbol, V. The volt is the difference of electrical potential between two points of a conducting wire carrying a constant current of one ampere when the power dissipated between these points is equal to one watt.

The volt is used universally and will require no change. It can be expressed directly in terms of SI base units as follows: $kg\text{-}m^2/s^3\text{-}A$.

Electrical conductance: unit, siemens. symbol, S. The siemens is the electrical conductance between two points such that a potential difference of one volt produces a current of one ampere. The siemens is identical to the mho and the reciprocal of the ohm. It was introduced by the International Electrotechnical Commission in 1935 and accepted as part of SI in 1971.

Magnetic flux: unit, weber. symbol, Wb. The weber is the magnetic flux which, linking a circuit of one turn, produces in it an electromotive force of one volt as it is

energy	kilowatt hour	kW h	3.6×10^6 J
energy	thermochemical calorie	cal(thermochem.)	4.184 J
energy	I.T. calorie	cal_{IT}	4.1868 J
thermodynamic temperature (T)	degree Rankine [2]	°R	(5/9) K
common temperature (t)	degree Celsius [2]	°C	$t/°C = T/K - 273.15$
common temperature (t)	degree Fahrenheit [2]	°F	$t/°F = T/°R - 459.67$
radioactivity	curie	Ci	$3.7 \times 10^{10}\ s^{-1}$

[1] The conventional millimetre of mercury, symbol mmHg (not mm Hg), is the pressure exerted by a column exactly 1 mm high of a fluid of density exactly 13.5951 g cm^{-3} in a place where the gravitational acceleration is exactly 980.665 cm s^{-2}. The difference between 1 mmHg and 1 Torr is less than 2×10^{-7} Torr.

[2] The ° sign and the letter following form one symbol and there should be no space between them. *Example*: 25 °C not 25° C.

reduced to zero at a uniform rate in one second.

Although the weber was introduced in 1891, is was not accepted in SI until 1960. It replaces the obsolete CGS unit, the *maxwell.*

Magnetic flux density: unit, tesla. symbol, T. The tesla is a magnetic flux density of one weber per square meter. It is a recent unit, proposed in 1956 and accepted in 1960. It will replace the *gauss.*

Other SI electrical units are the ohm, coulomb, farad and henry. Further derived units are too numerous to mention. The units for dynamic viscosity are pascal— seconds rather than N-s/m^2. Electrical resistivity is expressed in ohm meters rather than ohms per circular mil-foot.

SPELLING AND PRONUNCIATION

The base unit for temperature is the kelvin. Until 1967 it was known as degrees kelvin with the symbol ^{0}K. It has now been changed to conform with the other SI base units and is symbolized by K.

For everyday temperature measurement, degrees Celsius (^{0}C) is used. The degree mark is always included in front of the C to avoid confusion with the coulomb.

SI rules dictate that the symbol for a unit named after a scientist be capitalized, but that the complete name not be capitalized. An exception is degrees Celsius, which has a capital C. The degree Centigrade has been obsolete since 1948, though that might be hard to believe after looking at a few scientific journals.

An almost trivial argument has raged over whether to spell the base unit of length as *meter* or *metre.* The latter spelling is standard only in France, Turkey, and in Great Britain, where it is illogical.

Decimal fractions and multiples of SI units having special names

These names are not part of the SI. It is recognized that their use may be continued for some time but it is recommended that except in special circumstances they should be progressively abandoned in conformity with international recommendations. The following list is not exhaustive.

Physical quantity	Name of unit	Symbol for unit	Definition of unit
length	ångström (1)	Å	10^{-10} m = 10^{-1} nm
length	micron (2)	μm	10^{-6} m
area	barn	b	10^{-28} m^2
volume	litre (3)	l	10^{-3} m^3 = dm^3
mass	tonne	t	10^3 kg = Mg
force	dyne	dyn	10^{-5} N
pressure	bar	bar	10^5 N m^{-2}

IMPLICATIONS FOR TRADITIONALLY METRIC COUNTRIES

As should be obvious by now, even metric countries will have difficulty converting to the use of SI. Their engineers must abandon technical metric units and CGS units which are now obsolete. The newton, pascal and joule will be new for most countries as will the use of watts for mechanical measurements.

Standards experts in some European countries claim that resistance to these relatively minor changes is greater than in English system countries, where a complete transition to SI units is necessary. Nevertheless, at least sixteen countries have undertaken to conform to SI.

SETTING SI STANDARDS

Great Britain is converting to

Derived SI units and unit symbols for other quantities

(This list is merely illustrative)

Physical quantity	SI unit	Symbol for SI unit
area	square metre	m^2
volume	cubic metre	m^3
density	kilogramme per cubic metre	kg m^{-3}
velocity	metre per second	m s^{-1}
angular velocity	radian per second	rad s^{-1}
acceleration	metre per second squared	m s^{-2}
pressure	newton per square metre	N m^{-2}
kinematic viscosity, diffusion coefficient	square metre per second	m^2 s^{-1}
dynamic viscosity	newton second per square metre	N s m^{-2}
electric field strength	volt per metre	V m^{-1}
magnetic field strength	ampere per metre	A m^{-1}
luminance	candela per square metre	cd m^{-2}

energy	erg	erg	10^{-7} J
kinematic viscosity, diffusion coefficient	stokes	St	10^{-4} m^2 s^{-1}
dynamic viscosity	poise	P	10^{-1} kg m^{-1} s^{-1}
magnetic flux	maxwell	Mx	10^{-8} Wb
magnetic flux density (magnetic induction)	gauss	G	10^{-4} T

(1) It is understood that the Triple Commission of Spectroscopy (which has representatives from the International Astronomical Union, the International Union of Pure and Applied Physics, and the International Union of Pure and Applied Chemistry) is unanimously in favour of the continued use of the ångström.

(2) The symbol μ is still unfortunately used by some spectroscopists and biologists instead of μm, and likewise the symbol mμ, instead of the symbol nm.

(3) By decision of the twelfth Conférence Générale des Poids et Mesures in October 1964 the old definition of the litre (1.000 028 dm^3) was rescinded and the word litre reinstated as a special name for the cubic decimetre. Neither the word litre nor its symbol l should be used to express results of high precision.

the metric system and it appears that the US will follow suit, but that doesn't mean that their products will be compatible with ours. There are not yet any accepted metric *standards*. Just because your car is made with metric bolts doesn't mean that it is made with *standard* metric bolts. A 6mm and an 8mm wrench are useless in loosening a 7.25mm bolt.

Several different standard setting systems are competing for acceptance. The failure to set uniform standards for magnetic tape widths, tubing diameters and screw sizes could leave us right back where we were with the English system—unable to trade with the rest of the world.

Renard numbers: The Preferred Number Series are an important feature of many international metric standards. They are also called Renard numbers, after French Colonel Charles Renard. Based on logarithmic principles, they provide for a rational selection of sizes or other values. The system was published in 1952 (see table 2).

The preferred numbers are defined in the range 1 through 10, but they can be multiplied by any power of 10. In this way, any series can be indefinitely extended.

The R number indicates how many values there are in each decade (order of magnitude). The regularity of the increments can be demonstrated in several ways. In the R.10 series, each value is approximately 25% larger than the previous one and the numerical values are doubled every three steps. In the R.20 series, the values double every six steps.

The lowest R number is usually perferred in order to save inventory cost. Some standards contain numbers from several series even though the parts in high R numbers are not likely to be stock items or may carry higher prices.

International standards that have used Renard numbers include sheet metal thicknesses, wire diameters, nominal diameters of screw threads, standard current values, and bore diameters of rubber hoses.

When metric measures are introduced, corresponding metric standards must be introduced. Much of industry will probably try to get by with just assigning metric units to old standards. It will be through the introduction of metric standards, however, that industry will reap the greatest benefits. The following examples illustrate what can be done through the use of metric standards:

Sheet metal and wire gauges: There are now some eight different gauge systems for sheet metal thicknesses in use in North America and six different wire gauge standards. Except for the "US Preferred Thicknesses", their numbers are all indirect: the higher the number, the smaller the dimensions.

Screw threads: By adopting the ISO metric screw thread standards, Great Britain is now in the process of reducing the possible combinations of screw threads, diameters, lengths and head shapes from 4000 down to 750.

There are 180 different screw thread systems in existence in

Prefixes for SI units

Fraction	Prefix	Symbol	Multiple	Prefix	Symbol
10^{-1}	deci	d	10	deka	da
10^{-2}	centi	c	10^2	hecto	h
10^{-3}	milli	m	10^3	kilo	k
10^{-6}	micro	μ	10^6	mega	M
10^{-9}	nano	n	10^9	giga	G
10^{-12}	pico	p	10^{12}	tera	T
10^{-15}	femto	f			
10^{-18}	atto	a			

Printing of numbers

Numbers should be printed in upright type. The decimal sign between digits in a number should be a point (.) or a comma (,). To facilitate the reading of long numbers the digits may be grouped in threes about the decimal sign but no point or comma should ever be used except for the decimal sign.

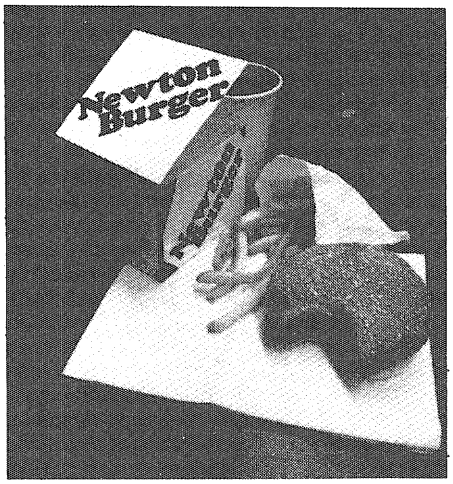
Example: 2 573.421 736 but not 2,573.421,736

When the decimal sign is placed before the first digit of a number a zero should always be placed before the decimal sign.

Example: 0.2573×10^4 but not $.2573 \times 10^4$

It is often convenient to print numbers with just one digit before the decimal sign.

Example: 2.573×10^3



various countries (twenty of which are metric). The widespread use of ISO standards promises tremendous simplification.

ISO standards are opposed in the US by the Industrial Fasteners Institute, which has been conducting a campaign to convince American and Canadian engineers that ISO screw threads have serious shortcomings and that their documentation is inadequate. The Institute is trying to develop a superior metric standard that has only one system of 25 diameter and pitch combinations in contrast to the ISO standard, which has separate series for coarse and fine threads and 26 preferred values in each. The Institute also advocates a shallower thread depth.

Serious confusion would result if the Industrial Fasteners Institute prevails in the US while the ISO standards are used in Europe.

Textile fibers and yarns: There are now 29 different numbering systems for the linear density of textile fibers in use and most of them are indirect as are wire gauges. The metric standard will replace them with a Tex number which indicates line density in grams/1000 meters.

The Tex is a special unit that can be used with standard prefixes. German law recognizes Tex as a derived metric unit. Finnish customs tariffs have incorporated the Tex number for some years.

Paper standards: Paper standards is a complex area and we will not describe it fully. Paper is cut so that the length/width ratio is always the square root of 2/1. This means that if the paper is cut in half parallel to the shorter side, the same relationship of width to length will hold.

In the American system, paper is described in pounds per ream of large size uncut paper. For example, 20lb. typewriter paper weighs 20 pounds per 500 sheets of 17"×22" uncut paper. By introducing ISO paper sizes, the Royal Institute of Architects in Great Britain reduced their inventory from 37 different sizes to four. IBM(UK) Ltd. effected a 14% savings in stationery cost.

The metric description of paper is in grams per square meter (g/m^2). Some Americans abbreviate it as gpsm, which violates international rules. The A

Printing of symbols for units

The symbol for a unit should be printed in roman (upright) type, should remain unaltered in the plural, and should not be followed by a full stop except when it occurs at the end of a sentence.

Example: 5 cm but not 5 cms. and not 5 cm. and not 5 cms

The symbol for a unit derived from a proper name should begin with a capital roman (upright) letter.

Examples: J for joule and Hz for hertz

Any other symbol for a unit should be printed in lower case roman (upright) type.

Printing of prefixes

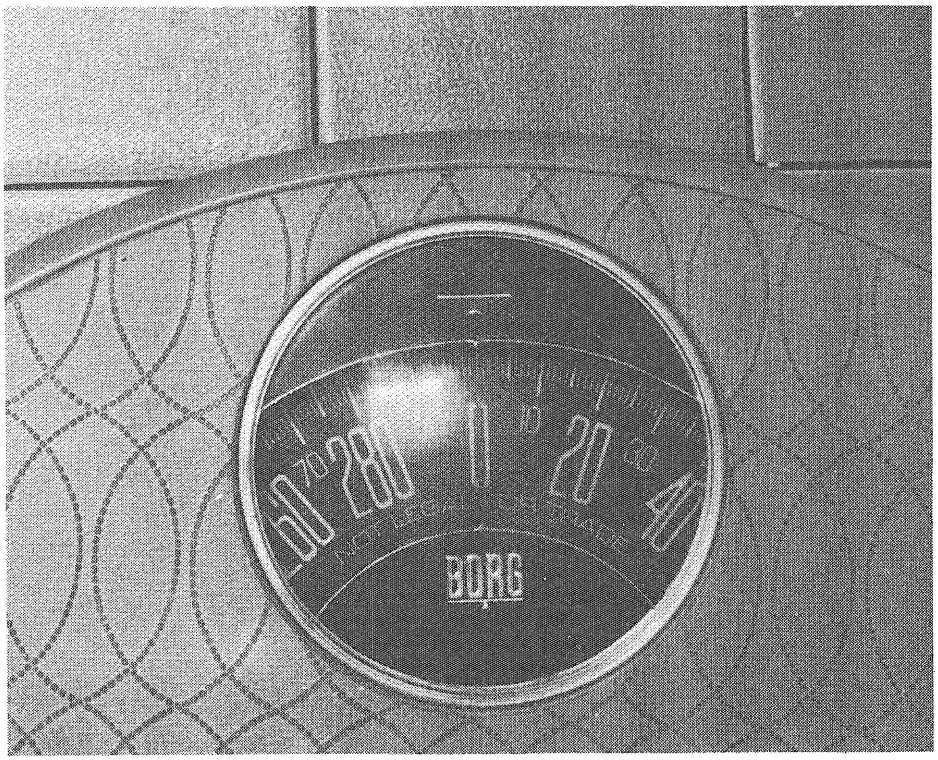
Symbols for prefixes for units should be printed in roman (upright) type with no space between the prefix and the unit. Compound prefixes should not be used.

Example: ns but not mμs for 10^{-9} s

Multiplication and division of units

A product of two units may be represented in any of the ways:

N m or N·m or N.m or N×m



The representation Nm is not recommended.

A quotient of two units may be represented in any of the ways:

$$m\,s^{-1} \quad \text{or} \quad m/s \quad \text{or} \quad \frac{m}{s}$$

or in any of the other ways of writing the product of m and s^{-1}.

These rules may be extended to more complex groupings but more than one solidus (/) should never be used in the same expression unless parentheses are used to eliminate ambiguity.

Examples: J $K^{-1}mol^{-1}$ or J/K mol but not J/K/mol

$cm^2 V^{-1} s^{-1}$ but not cm/s/V/cm; $cm\,s^{-1}/V\,cm^{-1}$ and (cm/s)/(V/cm) though algebraically correct are not to be encouraged.

Combination of prefix and symbol

A combination of prefix and symbol for a unit is regarded as a single symbol which may be raised to a power without the use of brackets.

Example: cm^2 always means $(0.01\,m)^2$ and never $0.01\,m^2$

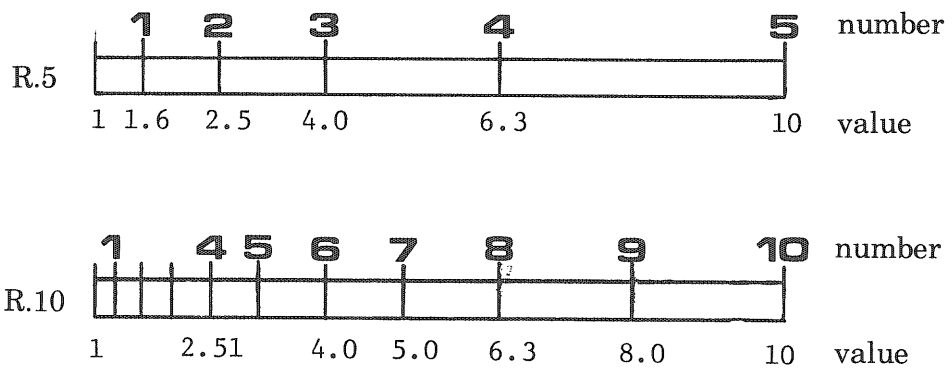
series is the main ISO paper series. The basic size AO has an area of exactly one square meter, 841×1189mm. The international letter size is 210×297mm.

Progress in standardization: Other metric standards reach far beyond the ones mentioned. Some experts believe that at least 15,000 standards will be required for our present state of technology.

Since 1950 the ISO has issued almost 2000 recommendations, and the International Electrotechnical Commission about 700. Of these, about 60% were finalized in the last three years. This indicates the rapid acceleration of standardization.

A significant change took place in 1972. Henceforth, documents produced by the ISO will be called International Standards instead of Recommendations. Over the next five years it is expected that all of the old recommendations will be converted into International Standards. ISO recommendations have already been introduced as national standards in some countries without changes. The Netherlands, for example, has adopted 150 ISO recommendations and 300 IEC publications.

It is clear that the US needs to participate in international standards work. If standardization can be increased in the future, the true benefits of the metric system can be realized.□



$$R(n)=10^{m/n}$$
$$m=1,2,3,....n$$

The Renard (Preferred Numbers) system divides an order of magnitude into logarithmically spaced divisions. The R number determines the number of divisions; thus R.5 is a series of five numbers, from 1.6 to 10.

Standard sizes set according to Renard numbers allow great design flexibility while reducing inventory size.

The system was designed by Charles Renard, a French baloonist, to standardize the ropes for baloons.

TECHNOLOG INTERVIEWS: Big Al & "MM"

One of the favorite watering holes on campus is the Big Ten Bar and Grill. The Big Ten is the home of several Beer Drinking records–the time it takes one, two, three or six people to down one goblet of beer. The goblets, with "I bet you can't" printed on the side, contain 160 oz. of beer each, which is 1.25 gallons, 2.22 six packs, or 4.73 liters, greater than the displacement of some V-8 engines. One of our talented staff members, "Big Al" Johnson, along with Tom "MM" Haberkorn, own all four of the men's records. When we found out what Big Al was up to, we rushed out to get the story.

We saw Big Al and Tom in action, putting away a goblet in under 3 min., 48 seconds. Professor Stokes, the fluid dynamics expert, insists that the viscosity of beer is too great and the human throat diameter too small to transport that amount of beer in so short a time. But experiment has proved other wise. So here is our unprecedented and exclusive interview with Big Al and Tom to fill you in on the details.

LOG: How did you get started in beer drinking, Al?

BIG AL: Well, when I was a freshman I was Mr. Straight Guy. I lived at home and went to movies alone on weekends.

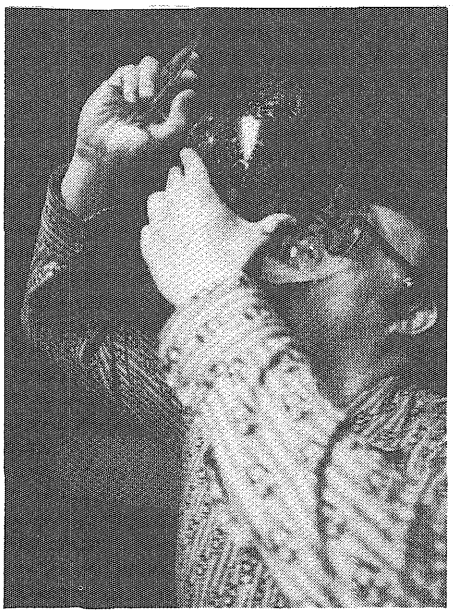
LOG: So what happened?

BIG AL: I moved into the dorm in my sophomore year. It wasn't so much moving into the dorm, but the roommate I got stuck with. My roommate was regarded as one of the hall's heavier drinkers.

LOG: Was he a big guy?

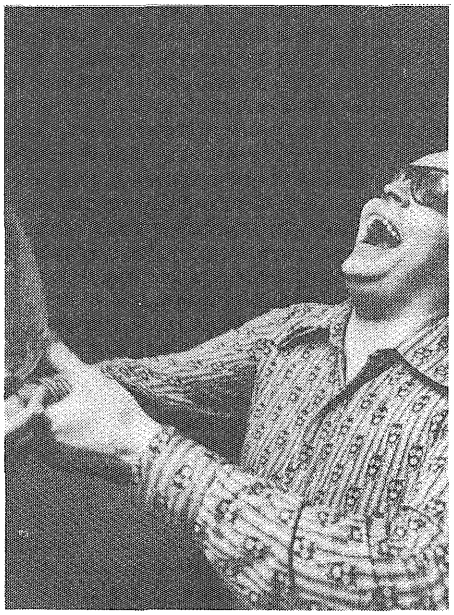
BIG AL: No, he was 5' 10" and 150 pounds.

LOG: That must have been quite a



When I was a freshman I was Mr. Straight Guy. I lived at home and went to movies alone on weekends.

Many have tried to break our records, but all have failed. Six freshmen came in, the best they could do was 47 seconds.



After the nineteenth glass I decided it was probably best that I went downstairs for a while.

contrast.

BIG AL: Yeh. He used to make jokes about me that were for real. For example, he would tell everyone about how he kept beer in an unlocked refrigerator and I didn't even touch it! You see, during that spring quarter he would hold at least two or three parties a week—on week nights! It got to the point that if you can't beat them, you have to join them. So I joined.

LOG: Is it true that you didn't get your beer drinking start at the Big Ten?

BIG AL: That's right. Across the street from the dorm where I lived

was Culla's Bar where they sold regulation pitchers of beer (60 oz.) for $.85. It's hard to find a good deal like that. Anyways, we started going there. Eventually we were on hand Sunday afternoons, Monday mornings. They opened at 10:00 am sharp.

LOG: What happened during your junior year?

BIG AL: I became a beer drinker. Fall quarter of my junior year I got into a drinking contest at Culla's. I bet my opponent that I could chug more beers than he could. I swallowed 22 to his 13. That night was the first and only night I worshipped the porcelain goddess. Wait, I did it another time. I'll tell you about that later.

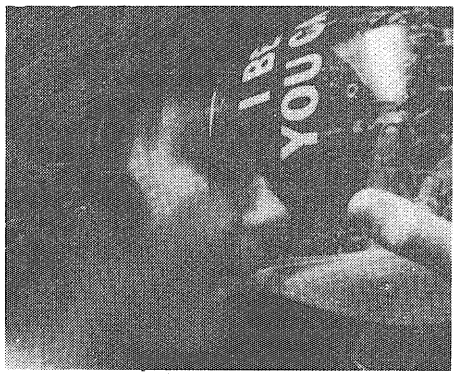
LOG: How did you get started at the Big Ten?

BIG AL: Winter quarter, between five and twelve of us started frequenting the Big Ten nearly every night. We would drink about two or three pitchers each in a night.

LOG: Who is Tom "MM" Haberkorn?

BIG AL: He's manager of the Big Ten, holds a masters degree and is presently completing his PhD in linguistics. Tom speaks thirteen languages fluently and is a specialist in far eastern languages. Tom used to hang around the Big Ten alot, got a job as a bartender there, and started working heavily about two years ago. His capacity is renowned.

LOG: What happened the other



time you worshipped the porcelain goddess?

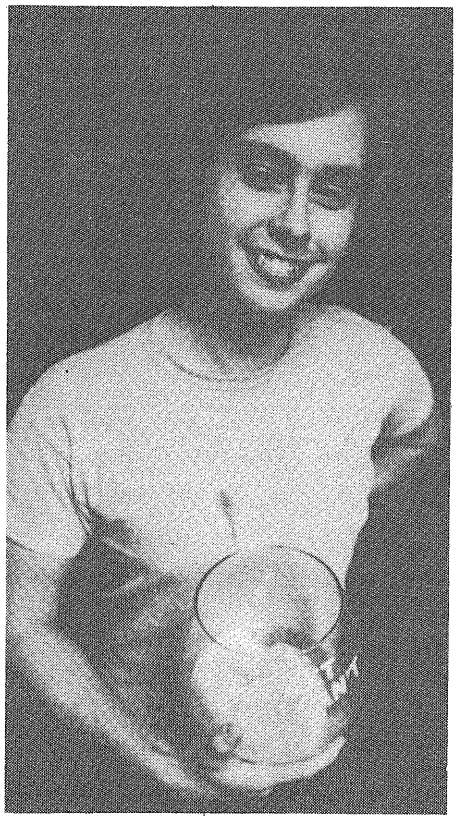
MM HABERKORN: Well, while I was tending bar, Al, his roommate, and another guy came into the Big Ten at about 7:00. Al had decided to have a drinking night. By 9:30 he had finished three pitchers and some more people came over. At this point, Al got serious and chugged another nineteen beers. I joined him on the last three, but then I had to drink alone, because Al was downstairs. Admiring the graffiti, I imagine.

BIG AL: I wear contact lenses and I totally forgot to take them off when I crashed into bed that night. Anyways, I woke up the next morning, looked at the clock, and I could see it perfectly. My first thought was, "I should drink more often! It does wonders for my eyesight."

LOG: What are the important beer drinking records?

BIG AL: Tom holds the one man record. It took him 19 minutes and 43 seconds to drink a 160 oz. goblet of beer. Tom and I hold the two man record which is 3 minutes and 48 seconds. The three man record is held by Tom, Brian Harvey and myself. It took the three of us passing the goblet back and forth 1 min. and 55 seconds. The six man record is 15 seconds, with six people drinking through straws all at the same time. The one woman record is 1 hour and 28 minutes. For two women it is 7 minutes, 58 seconds and for three women its 3:03. A one man, one woman record may be set soon.

LOG: Who's Brian Harvey?



BIG AL: Harv is a 6' 3" 215 lb. regular at the bar and Tom's roommate. I remember one night when I was bartending, Harv had been drinking for quite a period of time and he decided to streak—but Harv's version of streaking is more appropriately called strolling—Harv is too big to streak. Anyways, Harv strolled through the bar, shook a couple of hands and kissed a few girls with just his socks on. He then strolled up to the foosball table where four girls were playing and put his arm around one of the girls. She looked at his face and continued playing foosball. Then she looked at his upper torso and noticed that he didn't have a shirt on. This registered in her mind and she returned to her foosball. Then she turned around and, looking at his lower torso, let out a scream—"Ahhhhh"—at which time everyone at the foosball table burst out laughing. Harv strolled away, put his clothes back on and ate three glasses.

LOG: You mean drank three glasses....you don't? How do you eat beer galsses?

BIG AL: You chew them very well. Just like Yul Brynner when he played a Russian Army colonel and he wanted to impress the Hungarians.

LOG: What happened after he ate them?

BIG AL: The Hungarian innkeeper sent word....

LOG: No, I mean after Harv ate the glasses.

BIG AL: Harv's mouth was bleeding and he ran around the bar yelling satirically, "I'm going to die, I'm going to die!"

LOG: Moving right along, what are some of the rules for beer chugging?

BIG AL: First of all, you can't spill more than a little bit between all the members of your team. Secondly, if you break the record you must remain in the bar for at least half an hour after afterwards to let the bartender verify that you haven't upchucked. Last year Tom and I had gotten the two man record down to 3 min. 3 seconds but Tom spit up just a little afterwards so the record didn't count.

LOG: What are some qualifications for a beer chugger?

BIG AL: The guy has to have at least a 4.88 liter stomach. His coefficient of absorption must be greater than 6. Also, you must have been a heavy drinker for at least a year.

LOG: Is there a time when a beer chugger's performance peaks out?

BIG AL: Yes, like with any sport the athlete's ability is a function of years, $a=f(y)$ is such that $da/dy=0$ at about the tenth year. Thus he peaks out at about his tenth year.

LOG: Of age or of beer drinking? Never mind. I suppose the teammates have to be compatible also.

BIG AL: That's correct. For example, in two man chugging, you chug for about 20 seconds and your partner chugs for about twenty seconds which gives you a little bit of time to recover. I can chug longer than Tom but I drink slower. I also start slower but I end faster. Tom Starts faster and ends slower. This creates a perfect mesh for our drinking team.

MM: That's correct. For example, in two man chugging, you chug for about 20 seconds and your partner chugs for about twenty seconds which gives you a little bit of time to recover. I can chug longer than Al but I drink slower. I also start slower but I end faster. Al starts faster and ends slower. This creates a perfect mesh for our drinking team, an almost unbeatable combination.

LOG: Who can try for the record?

MM: Anyone compatible with the bartender can come in and try to break our record. If they succeed, they get the beer for free.

LOG: Have many people tried?

BIG AL: Many have tried, but all have failed. Six freshmen came in to try the six man record, but the best they could do was 47 seconds.

LOG: Al, what's the future of beer chugging in Minnesota?

BIG AL: Beer chugging appears to be in serious trouble. We are very disappointed that the Minnesota State High School League and the state legislature have left our state behind the times by not sanctioning beer chugging as a high school sport. It puts our college drinkers at a severe handicap since there is not nearly enough drinking in high school to give them the training they need. Other than that I see a tremendous future for beer chugging, barring a disaster.

LOG: Thank you, Tom and Al, and the best of luck.

TOM & AL: Thanks, Log.

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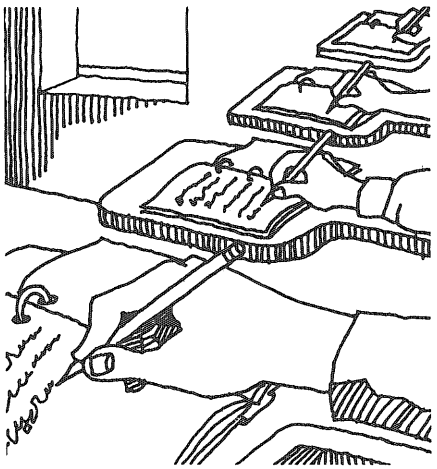

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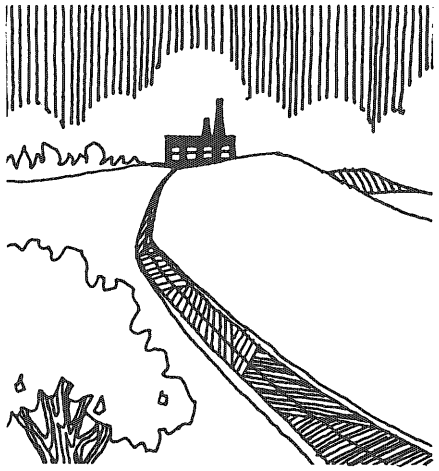

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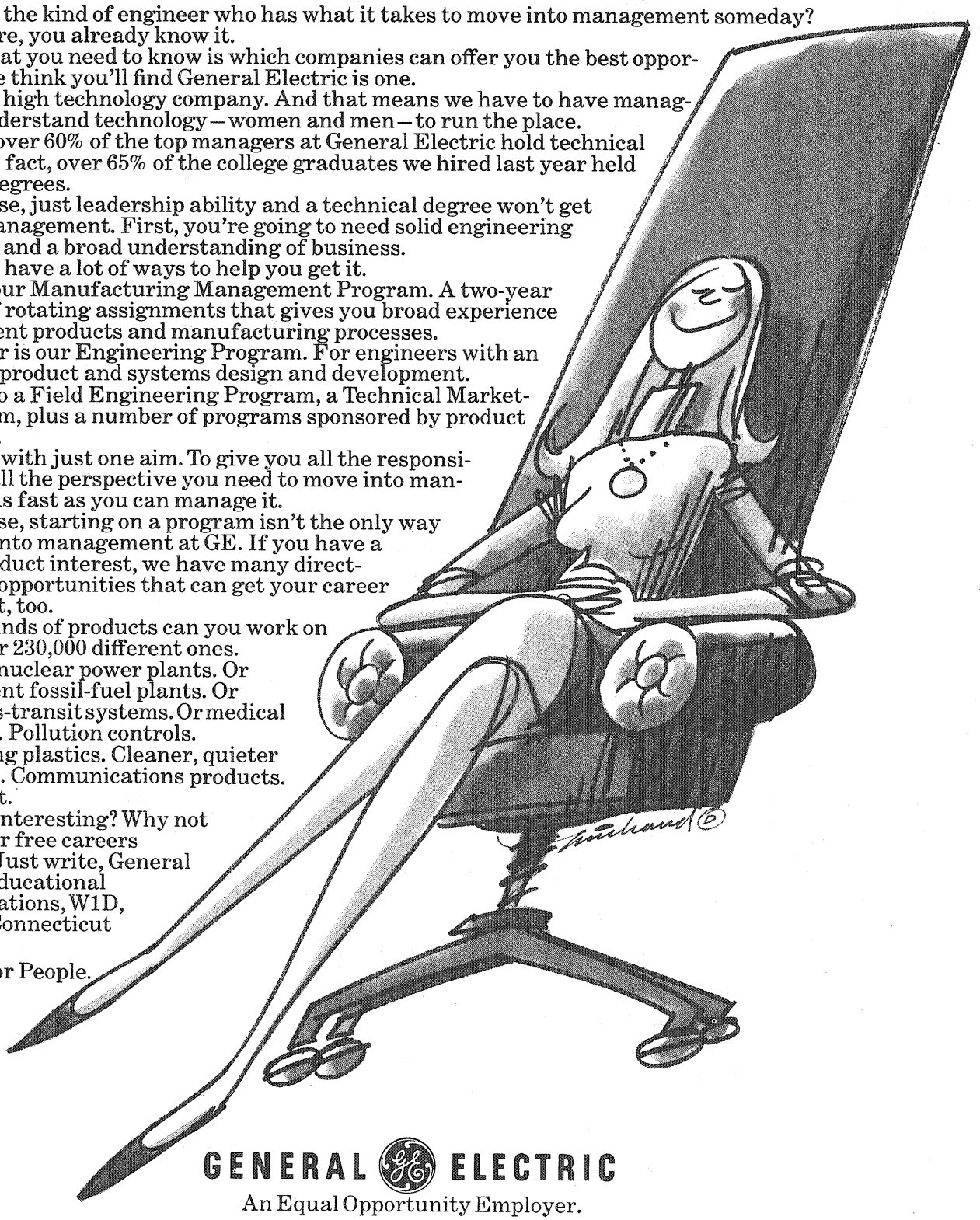

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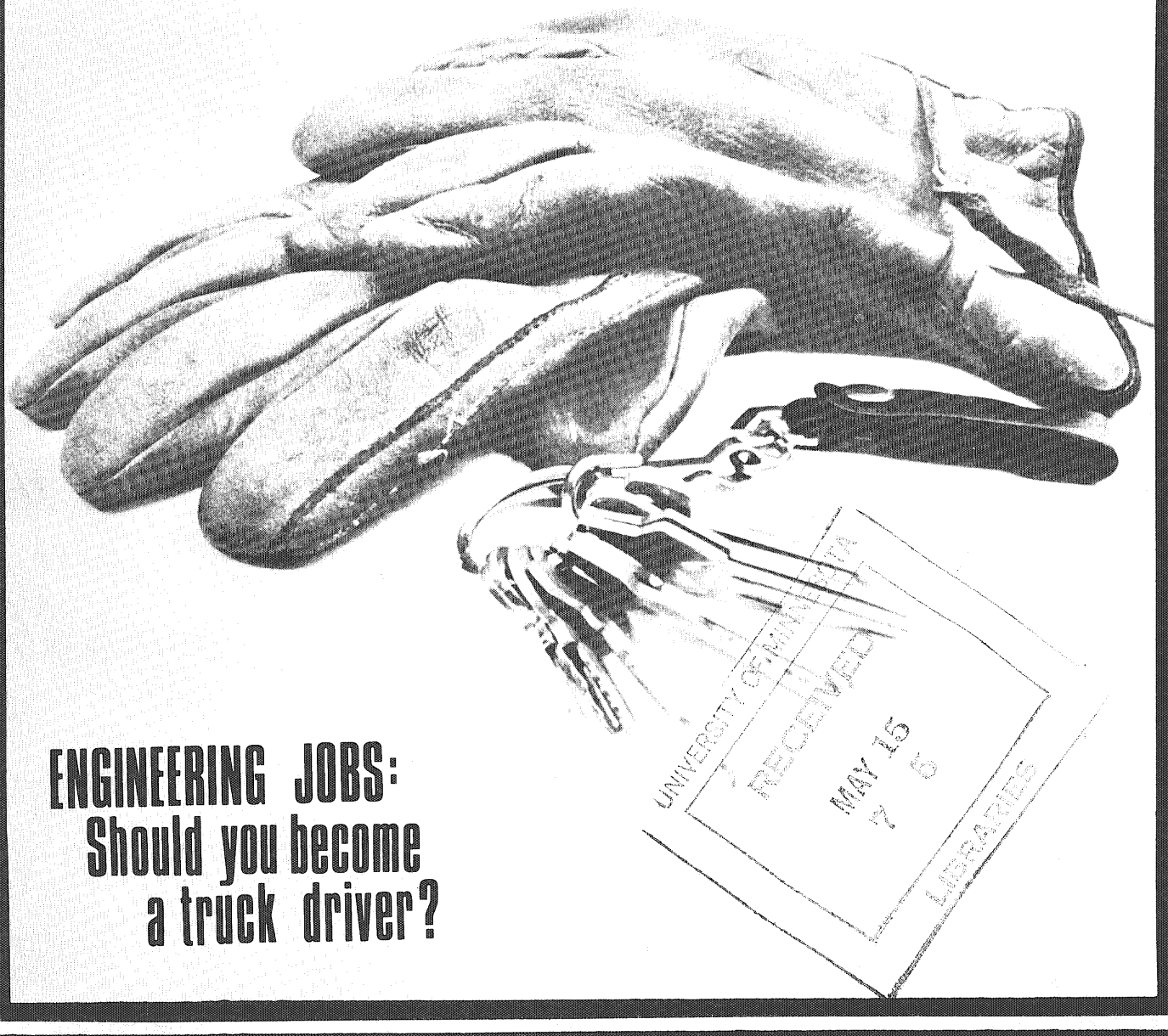

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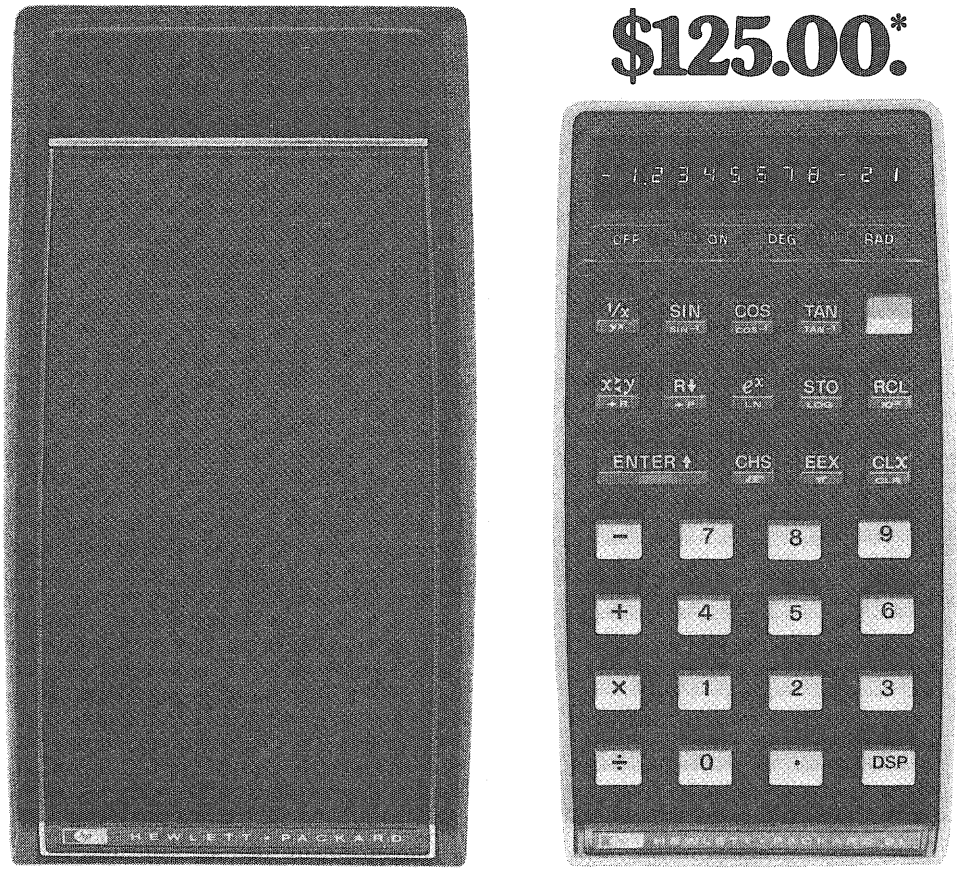

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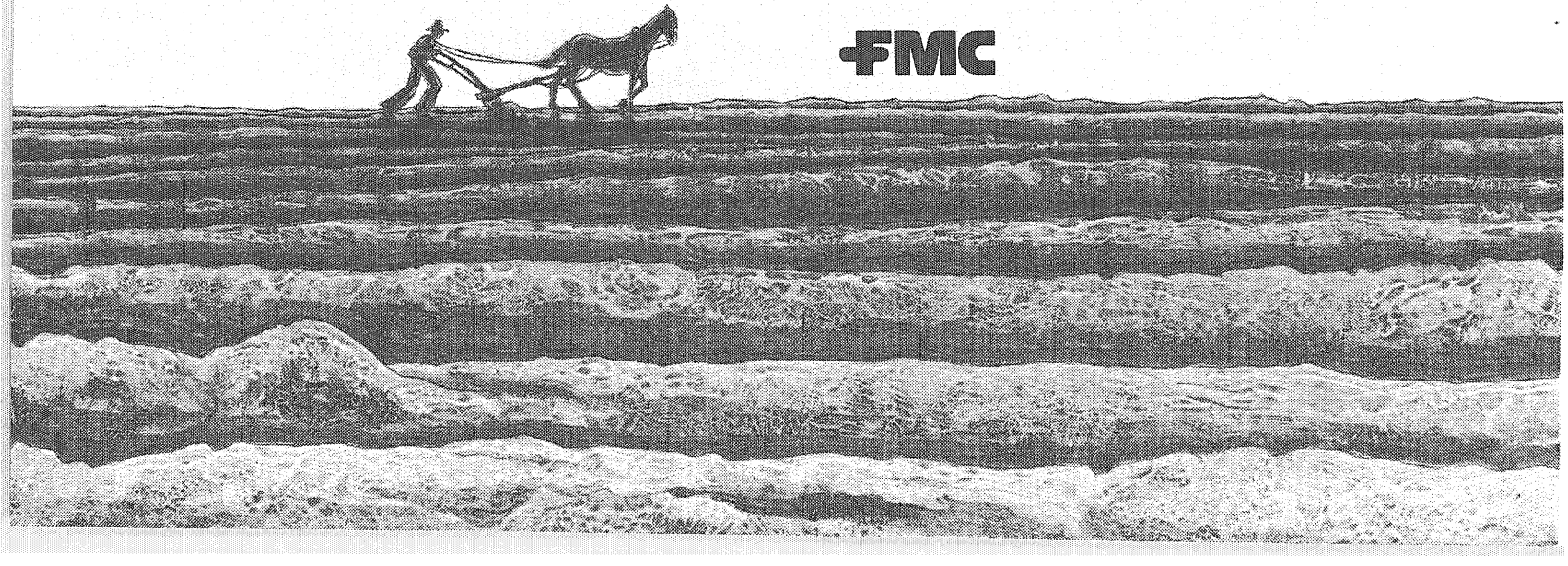

minnesota **Technolog** spring | 1975

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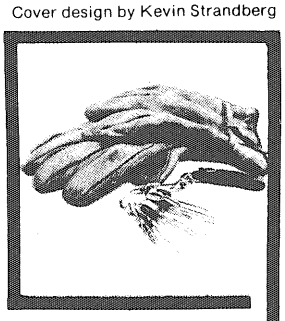
All illustrations and photos in this magazine should be credited to Kevin Strandberg, with one exception;

The Technolog would like to thank R. Crumb for the free use of his illustrations in the "Conscience and Crisis" article. We would also like to note that these illustrations are copyrighted and reproducing them without the authors permission is prohibited, unless you do not mind being sued.

Vol.55, No.5

Cover design by Kevin Strandberg



Technolog editorial pages

The Technolog is proud to present, with all the pomposity it can muster, the 1975 annual Technolog Achievement Awards.

The Technolog's Annual Marvin memorial award, for editor of the year.

We were going to present this award to the present **Technolog** editor, Bob Pirro, but we were unsure that Pirro was still going to be editor by the time this magazine went to press. Besides, if we had found him, we would have had to wake him up.
We actually should present the award to the revolving door which must exist at the entrance-way to the **Technolog** editor's office. However, we have decided to present the award to Janet Barrett, business manager of the **Technolog**.
According to reliable sources, Ms. Barrett personally took the time, effort and determination necessary to drive the first **Technolog** editor, Tom Kraemer, insane. She then applied equal diligence in dispatching the second **Technolog** editor, Larry Yarosh. Currently, she is deeply embroiled in a campaign to drive the present **Technolog** editor, Bob Pirro, crazy.
According to a long-time **Technolog** office fixture, Bill Loye, "driving Pirro crazy is no mean feat. He was editor last year, and now he's come back again, so you **know** he has got to be nuts."
Barrett concurs saying "I'm running out of challenges. Now, they're giving me re-runs."
Ms. Barrett concluded by saying "they're just not making **Technolog** editors like they used to."

The "Baby The Rain Must Fall" award for the movie of the year

This year's award goes to the motion picture "Lenny", starring Dustin Hoffman. "Lenny" is a supurb effort, showing how easily a second-rate comic can be passed off as a martyred social pioneer, and a second-rate actor can be passed off as an academy award nominee.

The Fester Bestertester memorial award for outstanding scientific achievement

This year's award goes to Mr. Kenneth Johnson of San Diego, California.
Mr. Johnson was a college student when he performed his great scientific achievement, which involved microwave energy.
it seems that Mr. Johnson obtained a conventional microwave oven and took off all the safety features and interlocks, so the oven would cook even when the door was open. He then proceeded to shampoo and then to dry his hair by sticking his wet head into the running microwave oven. After a few seconds, his hair caught on fire. At this point of the experiment, he ran out of the room. Onlookers were unsure if he was a Bhuddist monk protesting something, or if he was trying to start a new religion, or is he was signaling an early start to the next Olympic games.
Our award will be mounted on his, hopefully fireproof, mausoleum.

The Black Hole of Calcutta memorial award for the best meeting place of the year

This award goes to the **Big 10**, for allowing the **Technolog** staff to hold it's weekly staff meetings there. These meetings, where vital business is discussed, occur every Friday afternoon until 5:00 or until Kathy Chase falls under the table, whichever comes first. In presenting the award to the **Big 10**, the **Technolog** would like to express its profound gratitude to Big Al, the bottomless male exhibit, and the perpetually broken popcorn machine, for never throwing us out, even when we needed it.

The Fabian Forte--Leon Russel Memorial singer of the year award.

This award goes to John Denver, who is just a good old-fashioned country boy--from Edina, Minnesota. As Joni Mitchell would say, John Denver "is on the star-maker machine", specifically, the NBC-TV--RCA Victor records star-maker machine.
We certainly do not begrudge success to John, even though he has, as one **Technolog** staffer put it "a face that you'd love to punch."
It was interesting when he told a national television audience of how he broke three of his wife's ribs on their wedding night. Perhaps he was trying to produce a child in the true Biblical sense, but after the break he took a sex education course and learned the correct entry procedure. Even so, we are not sure that we would like to spend "An Evening With John Denver."

The Dick Tracy--Dondi Memorial Cartoon Strip of the Year Award.

This award goes to the comic strip "Doonesberry" by Gary Trudeau. This strip gives tremendous inspiration to us all. It is wonderful to see that someone can still produce a successful comic strip without knowing how to draw at all. To call Trudeau an artist is to call Earl Butz a statesman. It is not true that Trudeau uses the same face for each of his characters, although there is some basis in fact for the opinion that he got his drawing style from studying the artwork on ancient Egyptian vases.
Actually, Trudeau creates an enjoyable strip. However, we feel that someone who spends his time taking cracks at everybody else deserves a little buckshot himself. Besides, our layout staff can readily identify with Zonker.

The "My Mother The Car" memorial award, presented to THE television show of the year.

This years award goes to the television series"Apples Way." A CBS series, Apples Way" was created by Earl Hammer, the genius behind "The Waltons." Following a basic television spin-off formula, Hammer and CBS figured"If they liked 'The Waltons', they'll **love** "Apples Way."
Based on a California family moving back to Iowa to discover the old-fashioned values that made America what it is today, "Apples Way" gave a supurb demonstration of how modern American television is programmed for an immature idiot--a dreamer and/or simpleton who thrives on nostalgia and corn.
"Apples Way" replaced last year's winner, "The Sonny and Cher Comedy Hour" as the show most likely to be enjoyed only when the viewer is stoned.
The all-time greatest "Apples Way" episode had to be "The Storm", which will be to 1995 audiences what "Reefer Madness" is to 1975 audiences. In this show a) the Apple farm is struck by a tornado, b) George Apple (the father) is hopelessly trapped in a root cellar where he is certain to either lose a leg or die from loss of blood, c)the family car is overturned and crashes, with Mrs. Apple and Grandpa Apple in it, and d) the youngest Apple, Steven, is hopelessly lost in that storm. Not only does Mrs. Apple and Grandpa walk away from the car crash, but they find Steven in the storm and he rushes back to rescue George Apple in the root cellar. The only thing missing was to have an itinerant preacher, known only as "J.C." touch George's leg and heal it on the spot.
CBS and Earl Hammer ought to receive a little something special--like a boot in the teeth--for marketing such blatantly insulting trash and actually expecting people to accept it. Maybe they felt they had to do something to counter the success of "Hee Haw."

The 1962 New York Mets memorial award for outstanding sports achievement

This year's award goes to the 1975 U.S. National Olympic Hockey Team. In the world amateur hockey championships, recently held in Germany, the U.S. team compiled a record of 0 wins and 10 losses. While amassing these auspicious results, the U. S. team scored a total of 22 goals while having 84 goals scored against them. In other words, the average score for each game was better than 8-2 against the U.S. team.
In selecting this team, coach Bob Johnson recruited such stars as Gopher scoring "wizard" Buzz Schneider, who ultimatelyled the U.S. team in scoring, and Minnesota "badman" Mike Polich, who led the team in penalty minutes. Anybody who followed the hockey Gophers this year knows how pathetic those statistics really are. Schneider and Polich are not bad, but they should not be the stars of the team--a team which has to compete against such clubs as the Russian juggernaut which annihilated the 1974 Team Canada entry.
After last season, Canada decided to stop sending a delegation to these games. They realized that their best players were competing in the professional ranks and why should they embarass themselves by sending over an inferior team? Perhaps the U.S. will eventually get the hint, but not before the 1976 games.
They are already committed to play in the 1976 Olympics, although, based on their pathetic display this year, they will have to play in the lower, or "B" level of competiton. This American team will be recognized as the second-rate club that it is and they will be competing against the likes of Japan and Italy.
They had better be careful, though. We hear that the Mexican hockey team is going to be a real powerhouse!

The Minnesota Loon memorial award for the University of Minnesota publication of the year

This year, the award goes to the 1973-74 "Official University of Minnesota Campus Bulletin." The "Bulletin" once again neglected to include the **Minnesota Technolog** as an official student organization. The fact that the **Technolog** has published continuously since 1920 and has been an officially registered student organization for as long as student organizations have been registered and recognized, makes this oversight even more ironic.
To top things off, the "Bulletin" has not only refused to recognize the **Technolog** this year, but for the last five years as well.
Commenting on this situation, **Technolog** editor Bob Pirro said "I'm not worried. The **Technolog** is a lot like Red China. Some people may not recognize us, but we're here."

what is a roving photon?

Read This Article and Find Out

by Richard Morey

Socially and academically the University has often been a cold, isolated place for the physics major. Unlike the engineering student, there was no club or fraternity with which he could identify or belong to. Periodic attempts to organize a group such as the Society for Physics Students (SPS) have always failed, until this last spring quarter. For it was then that the Roving Photons began to provide the physics major with their own group.

Why were the Photons founded? "We felt there was a need for an undergraduate physics group" said Rick Dorshow, Executive Director of the Roving Photons.

The Photons started out as a group of eight physics majors, who formed an informal group for mutual aid in classwork and for small social gatherings. As time went on, they decided to find a common base of operations on campus. "One of the members had been an officer in SPS and suggested we try to get their old room" Dorshow said. "After we got the room, some of the guys wanted to keep it to ourselves. It was pretty nice, but we felt that we should do something for the physics department."

So far this year the Photons have arranged three special lectures on such topics as Particle Physics and Astronomy. They have also arranged a tour of the Tandem Lab. "We are trying to get an idea of what kind of research is going on in the physics department so that the physics major can get an idea of what he might like to do" says Dorshow. In addition, it is the Photons' hope that these lectures and tours will promote social interaction among physics majors and between students and faculty.

Besides the lecture series, Dorshow explained that he would like to see the Photons establish an undergraduate counselling service to help physics majors in planning their education. "Not that I'm saying that the faculty advisors are not doing their job," Dorshow clarified, "but they are not aware of all the offerings in some of the other departments. I think that the advice of another student, someone who has just been through it all, would be a great help."

An official representative on the curriculum committee was another goal for the Photons. They wanted a member on the committee and then Dr. Cahill, the Director of Undergraduate programs, asked a Photon member, Greg Hull, to be on the committee.

On the question of how well the department has accepted the Photons, Dorshow responded "the faculty, I think, have received us well. We have gotten very good reactions from the office." Dorshow elaborated on this point. "The department received a communique from the Chemical Rubber Company about a special rate for quantity sales on their handbook. Dr. Cahill turned it over to us, and we sold 40 books. If we had not been there, what would they have done? We saved some money for 40 students and provided a service to the department." The Photons have also had the responsibility of taking care of the publicity for a guest lecturer.

There have been problems along the way. Dorshow stated that "qw set our goals without realizing how long it would take. Inexperience is our biggest problem. Up until recently we were doing things haphazardly, stumbling over ourselves." Things are more organized now, however. "We are planning out the rest of the year, trying to make it less haphazard" Dorshow added.

Among the results of the planning is an attempt to relate their sponsored lectures and field trips, in order to give them a common ground. Dorshow wishes to set aside a certain time period, a month to six weeks in length for example, give it a theme and relate the lectures and field trip to that theme. Currently, Dorshow is planning on a theme for each month of this year. "April is Nuclear Physics month. We have several lecturers already, although we do not have a field trip yet. We hope to put nuclear physics on a level the undergraduate can understand. Ellementary Particle Physics is the theme for May. We would like to get someone to explain the significance of the new particles that are being discovered."

Low membership is a problem the Photons are trying to change. If the Photons are to survive beyond the graduation of their present membership they must include members of all the classes. Increased membership would also allow the Photons to conduct more social functions for physics majors.

Another problem facing the Photons is a lack of publicity, partly due to the fact that they are an unofficial student group. The Roving Photons were established and are supported solely by their own membership. Dorshow pointed out that official status for his group "will give us public exposure, which is something we do not have now. We will get our name in the Bulletin, so someone considering the University will know that we exist."

Asked what he thought the chances of survival was for the Photons, Dorshow replied "We're doing it. Slowly, but we're doing it."

For those interested in further information, the Roving Photons office is located in S-47, Tate Laboratory of Physics...down the same hallway as the Center for Aether Drift Studies.

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THE CURRENT JOB OUTLOOK FOR I.T. STUDENTS

by Robert Pirro

"students are not going to have the choice that they may have had in earlier years."

Initial indications are that 1974-75 is shaping up as a paradoxical year for college recruiting." This statement, which opens the January, 1975 **College Placement Council's Salary Survey**, sums up the current job outlook for engineering students.

"Cautious optimism" is the phrase used by Leroy Ponto, director of the I. T. Placement Office, in describing the local job outlook. "Cautious optimism describes the situation we are now in" says Ponto. "We do not want to sound like Polyanna and say that everything is wonderful, but we know that things are happening."

The national hiring picture is a muddled one, clouded by fluctuations, exceptions and unpredictable trends. For example, in October, 1974, the college recruiting picture was painted in bleak colors, except for engineers. It was generally thought that the engineering student would remain in high demand, regardless of how deeply the economic recession/depression affected the business community.

Initial indications reflected that this was an accurate view, as autumn recruiting was quite brisk. What actually transpired, however, was a gradually changing situation in which the recruiting activity was heavy, but the job offers were relatively light, and getting lighter. The January **College Placement Council Survey** reported that "the number of hires is expected to decline, while recruiting activity has increased, at least in the early months."

At first, the early figures did not bear this out, as the total number of national job offers, when comparing the fall, 1974 period to the fall, 1973 period, was up 5 percent at the bachelors level, 27 percent at the masters level and a whopping 80 percent at the doctoral level. In fact, the **College Placement Council** report went on to state that at that time (January, 1975) "the total number of job offers for this year (1974) is close to the all-time high in the 1960s."

However, the situation had changed significantly by March, 1975. That month, the **College Placement Council** reported on a much more pessimistic note; "early in the 1974-75 college recruiting year, all indications were that the outlook was dark for this year's college graduates except for engineering candidates...now, midway through the season, cutbacks appear to have hit engineering as well." The volume of offers to engineers dropped dramatically from a year earlier, with the bachelors level dropping 6 percent and the masters level declining 9 percent. Also, the dollar averages of the beginning salary offers did not change significantly from January to March. So the nation-wide slowdown appeared to be catching up with the engineer.

Yet, in the face of this situation, recruiting activity continued to be brisk, especially in the Minnesota area. Lee Ponto explains it this way "the companies are being more selective. There are fewer job offers and more takers than last year. The companies want to know early if you will accept their position. In other words, the engineering companies still want to hire people, but now they are being very very selective in just who they hire.

The Minnesota hiring picture is definitely brighter than the national scene, but even here, the slow-down trend in hiring is evident. The I.T. Placement Office was very optimistic during the summer, as they were hoping for a continuation of the banner year engineering candidates enjoyed in 1973-74. For the fall quarter there were approximately 150 companies signed up to interview candidates, which was a 35 percent increase over the fall, 1973 period. In fact, two major companies were looking to hire 10 percent of all the University engineering graduates.

Then, as Lee Ponto describes it, the situation slowly changed. "About three-fourths of the way through the fall quarter, things began to slow down. The fall was still good, as engineering was the bright spot in the college employment picture. We were able to place about 70 percent of our graduates during the fall quarter, which is a good average."

For the winter quarter, about 150 companies were set up to interview candidates, although roughly 135 of them finally did interview, which is also fairly normal. Yet the overall number of job offers was down. While certain candidates were able to attract numerous offers, this was getting to be a rarer and rarer occurance. Many students had to dig hard to get an offer and the companies wanted to know, very soon afterwards, whether the student would accept their position.

While there was by no means a panic, or a crisis situation, the luxury of multiple job offers for the vast majority of engineers was not to be.

One of the reasons given for the lowering rate of job offers was the high rate of job acceptance during the fall quarter. For whatever the reasons, the situation seems to be excellently summed up by Lee Ponto in this one sentence;"students are not going to have the choice that they may have had in earlier years."

Nobody seems to be pushing the panic button. There is certainly no rush by the engineering students, who are reportedly signing up for interviews at a normal rate. And there seems to be no real panic in the college or business community. Lee Ponto reports that "companies are talking to us about things picking up during the third quarter. They feel that we have already seen the worst that engineers will see."

Recent history points towards stability in the engineering job field. In this turbulent economic situation, engineering continues to enjoy overall success and stability. Most corporations realize that cutting back on their research&development departments is like cutting off their own lifeblood. Engineer unemployment rates have always been low. In December, 1974, less than one percent of engineers were unemployed. Even in 1970-71, which was the worst year in recent memory, unemployment for engineers did not exceed 5 percent. And both the companies and the colleges seem to be optimistic about their future needs. While companies recruit a variety of people, they will certainly feel the need, especially in the next few years, for the specialized, technical person. Lee Ponto "cannot help but feel that the technical fields will hold their own." Companies seem to have learned their lesson in 1970-71 when, as a result of widescale hiring cutbacks, the enrollment dropped in engineering colleges. "Companies want to keep their fingers in the pie now. Three months from now, if there is a boom in their particular area, they do want to be caught short" says Ponto.

In breaking down the hiring figures, there seems to be a steady consistency in the Minnesota hiring picture. Engineering, as usual, is holding up better than the sciences. Chemical engineering is probably number one in salary and demand right now, with mechanical engineering being number two. Unlike many other areas around the country there are no "soft spots" in engineering. In other words, there are no slow areas--all the engineering majors seem to be somewhat in demand.

Here is a capsuled progress report on some of the engineering fields. The figures stated here are drawn from both the **Engineers Joint Council Survey** and the **College Placement Councils Survey**. These figures are based on national averages and trends.

Aerospace Engineering was the field with the least demand during the first 6 months of the 1974-75 school year. The average starting salary was $1,048, lowest among the major engineering fields. Yet, this salary, which was only a 9.1 percent increase over last years salary (which was second lowest of all the engineering disciplines) shot up 3.5 percent during the first two months of this year--which was, by far, the highest rate of increase among all engineers.

Chemical Engineering was the fourth highest in demand nationally, even though the oil companies are hiring them at a tremendous rate. The average starting salary was $1,177, tops for any engineering B. A. candidate. The starting salary for a chemical engineer was also the highest for all engineers the year before. The 13 percent increase in starting salary over the last 12 months was the second highest rate of salary increase--only .1 percent behind metalurgical engineers.

On the masters level, the chemical engineer is third in demand but first in salary. They command an average of $1,286, a 9.7 percent increase over last year. On the doctoral level, the chemical engineer averages a starting salary of $1,612, a 4.0 percent increase over last year and a modest 1.3 percent increase so far this year.

Civil engineers are an enigma this academic year. The starting pay for civils is $1,058 for the B.A., which is second lowest among all engineering candidates. The average salary increase over last year is 9.4 percent, which is also the second lowest rate of increase. Civils, however, had the greatest increase in the number of job offers on the B.A. level, leaving them only behind mechanical and electrical engineers in being the most in demand.

This changes at the masters and doctoral levels, where the civil is the engineer least in demand. Salaries provide an even greater puzzle. The average masters starting salary is $1,192, an 8.2 percent increase over last year. Both this salary and the rate of increase are least among engineers at that level. However, the rate of salary increase for this year is 4.5 percent, highest among all engineers at the masters level.

The PhD candidate has a starting salary of $1,376, which is 3.5 percent down from last year but that figure is a whopping 32.3 percent up during the first months of this year. You figure it out.

Electrical Engineers have the second highest job demand and command the fourth highest starting salary among the B.A. engineering candidates. The average starting salary is $1,082, a healthy 9.7 percent increase over last year.

The masters candidate is in the greatest demand, yet they have the second lowest starting salary at that level. They begin at an average of $1,266, a 6.7 percent increase over last year, which is the lowest rate of increase for any engineer on the masters level. The PhD starts at $1,508, which is a 2.8 percent drop from last year, although that salary has risen 3.6 percent during this academic year.

Mechanical Engineering continues to be the most popular engineering discipline among engineering college graduates, even though there are more electrical engineers currently employed than any other engineering discipline.

The mechanical engineering B. A. candidate earns an average starting salary of $1,115, an increase of 11.4 percent over last year. Both figures are third highest in their respective categories. The masters candidate commands a starting salary of $1,274, second highest in this area. This figure represents the highest rate of increase on the masters level, a full 12 percent over last year's average starting salary .

The PhD graduate earns $1,591, second highest in this area. The rate of salary increase provides us with another paradox. While the overall salary increase over last year is 7.6 percent, highest on the doctoral level, the starting salary is down 2.2 percent for this academic year--the only discipline whose salary dropped on the PhD level.

TECHNOLOG INTERVIEW: ALFRED NORTH BLACKHEAD

Alfred North Blackhead was generally considered to be the most noted expert of his time. He pioneered in philosophy, mathematics and especially in logic. One of his greatest concerns was to make himself perfectly clear, even to the most patent dolt who would deign to read his works. He also patented the dolt in 1927, pat. no 7754788412898. Until his death in 1947, he continued to teach at Harvard University. We interviewed him at his tomb in Cambridge, England.

Q-How is death?

A-Death is a constant. It's volume is finite, but it's surface is infinite.

Q-Do you find that your cognitive apprehension abilities are improved?

A-Quite.

Q-What did you do for a living?

A-I amassed and wrote all the knowledge there is in logic, mathematics, philosophy and education. Apparently, no other knowledge exists.

Q-By the way, what is the basis of mathematics?

A-I have taken the point, which is the basis of all geometry, and I have destroyed it. I can re-create it, at a whim, which means that I can, at my leisure, destroy and re-create the entire structure of mathematics. That makes me God. But remember this--the point never existed. And I was the one who killed it. That makes me a Republican.

Q-What do you feel is the basis of logic?

A-I do not feel. I am an eternal form, like a color. Everybody with good senses recognizes me for what I am.

Q-What is the basis of logic?

A-The harmony of the logical reason which divines the complete pattern as involved in the postulates, is the most general aesthetic property arising from the mere fact of concurrent existence in the unity of one occasion.

Q-Can you elucidate that for us?

A-Well, since you obviously cannot fully comprehend it, let me make it perfectly clear for you. You see, the harmony of the logical reason which divines the complete pattern as involved in the postulates, is the most general aesthetic property arising from the mere fact of concurrent existence in the unity of one occasion. In other words, it means that for things to be together involves that they are reasonably together.

Q-You have made that point rather well, Mr. Blackhead.

A-Yes. That makes me a Democrat.

Q-Ideally...[Blackhead interrupts]

A-I can see that you are obviously an extreme idealist, like my colleague, Cardinal Snarkeley. Poor fellow. He felt that we only exist in the mind of God. He kept muttering limmerics such as "thoughts are made by fools like me, but only God can hear a tree."

Q-What is the basis of education?

A-Of course, now you are asking me what the basis of education is.

Q-You are a very perseptive man, Mr. Blackhead.

A-I quite agree. In considering education, at one time I felt that education should stimulate inquiry into parallel fields. Now, since I have proven conclusively that the point does not exist, and that there is no such thing as a parallel line, a field can only be understood as a volume. Therefore, I know that education should stimulate inquiry into confluent space-times.

Q-Would you please elaborate on that?

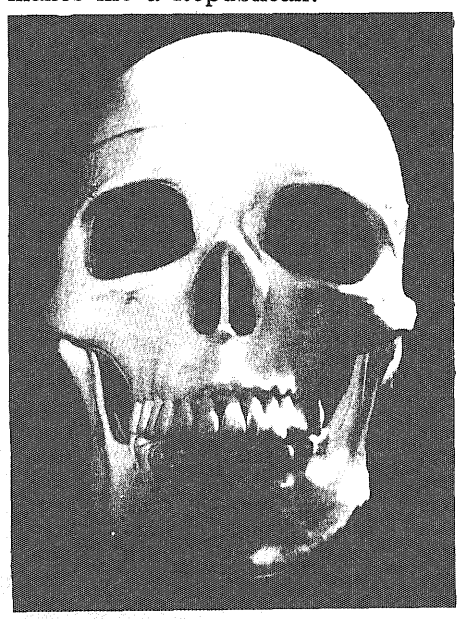
A-Certainly. The harmony of the logical reason which divines the complete pattern as involved in the postulates, is the most general aesthetic property arising from the mere fact of concurrent existence in the unity of one occasion.

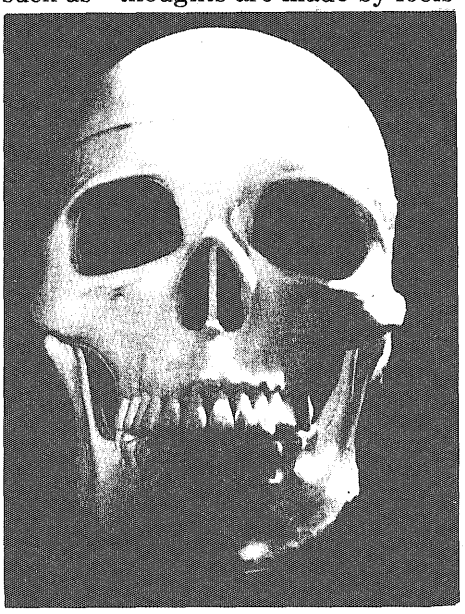
Q-What do you feel has been your greatest accomplishment?

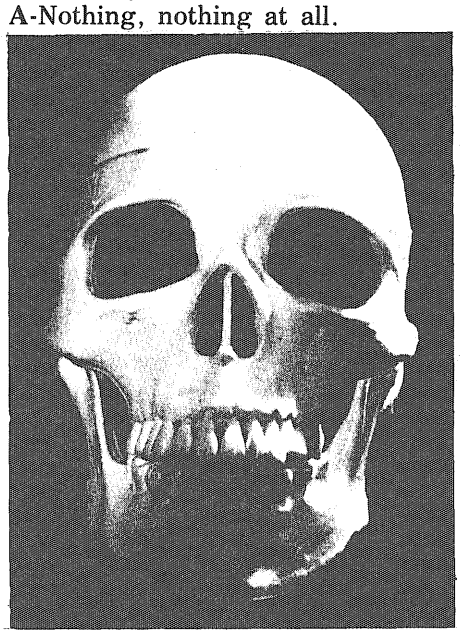
A-I have discovered a new number. It is the number **flebe** and it comes between the numbers seven and eight. For example, I was born in the year eighteen flebe seven, which was flebe eight years ago.

Q-Thank you Mr. Blackhead.

A-Nothing, nothing at all.







PRO

AN EXPLANATION

Mr. Robert Plumb, Main Eng. '75

Spring fever officially begins 5 May, 1975, at the BIG 10. With two free beers in the hand, to steady those jittery nerves from approaching midquarters, kicks off a celebration for those dedicated few who still survive.

I.T. has always been like that. To survive here requires more than burning the midnight oil. Call it luck, but Plumb Bob, that perpetual I.T. senior of infinite wisdom (yes Virginia, he passed Phys 1-290) has the key to Math 1-231. Its called E-Day, May 9th. This is when all those brave boys of I.T. storm out of classes at 10:00 sharp to participate the only known cure for I.Tediousness--a whole day of frivilous fun and activity. Heathen minds are once again re-immersed in the Pagan rites of spring rejuvination. That is the day to give that C.L.A. coed "the eye". Let her know that there are subjects other than Advanced Engineering 5-102 that command your intense study!

The festivities begin at 8:00 p.m. Monday, May 5th at the BIG 10. All I.T. students wearing an E-Day button are given two free beers, a pat on the back and a chance to make it with the cute blonde in the corner. Throughout the week those flabby muscles can toughen and tan playing tennis, softball and many other not-so-intellectual activities. Tell that blonde that you love her and she'll meet you at the Bed Race at 10:00 a.m. on Friday, May 9th. But stick around for the Homemade Car Race and afterwards the picnic--let her know that you are not just another college kid, but a man of I.T.. She'll really get it on at the dance at Coffman Main Ballroom, 9:00 p.m..

By Monday, with luck, you won't have the strength to get out of bed.

Plumb Bob

E-W

Here is the list of E-Week Activities.

Frisbee-golf
Shamrock Hunt
Tennis
Bed Race
Picnic
Egg Toss
I.T.Dance
Volleyball
Bowling
Foosball
Displays
Doofball
Car Race
Ping-Pong
Tug-o-war
Basketball
Chess Tournament
Paper Airplane Contest
Softball Tournament
Beer Drinking Tournament

Once again, E-Week is sponsoring a **FIND THE SHAMROCK** contest. This year the Shamrock is hidden somewhere in this universe and is worth $10.00. It would be worth more, but Plumb Bob is cheap. Incidently, if contests are your bag, see the Technolog ad on page 24, or the Editorial pages, four and five.

Clues to be published in Blarney's Castle.

If you are reading this page, please place a check mark in this box. ☐
Thank you. Now, please continue reading.

Here is the Plumb Bob mid-term examination. It consists of one question:

Where can anyone go to get reliable E-Week infornation?

a)--contact Scott Wattawa
b)--contact the **Minnesota Technolog** at 373-3298, or in Room 2, Mechanical Engineering building.
c)--contact the I.T. Board in 230 T.N.C.E.
d)--none of the above
e)--all of the above

The correct answer is E as in E-Week.

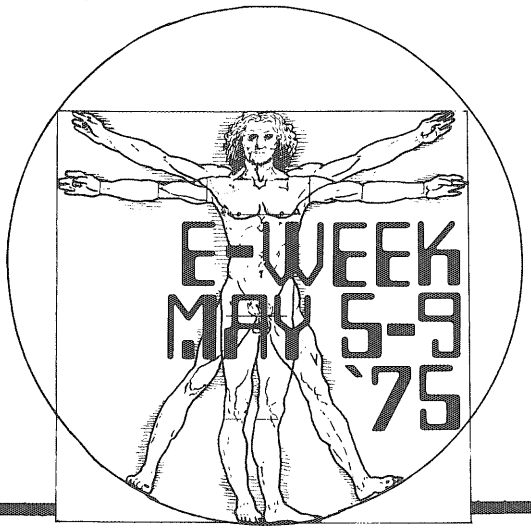
Here is the list of E-Day activities;

10:00 Grand Parade of Beds, Cars and Characters.
10:45 Set up for the Races.
11:00 Bed Race
11:30 Homemade Car Race
12:30 Awards for the Race Winners
1:00 PICNIC
Beer Drinking Contest
Egg Toss
Watermellon Seed Spitting
Paper Airplane Contest
Frisbee Golf
Tug-o-war between Engineers and foresters
9:00 DANCE! to CAIN at Coffman

DANCE WITH CAIN!!

THE big dance is Friday night, 9 May, starting 9:00. CAIN will be performing and admission is $1.00 to all those souls who are wearing an E-Week button. The price of admission is $1.75 for those who try to enter buttonless. Tickets will be available at the door and will also be on sale during E-Week. Watch the "Blarney's Board", just outside the Engineers Bookstore for details.

This is THE official 1975 E-Week button. Wearing this button during E-Week will allow the wearer; two free beers at the BIG 10 on Monday, May 5th, reduced admission to the dance, Friday May 9th, to buy ridiculously low priced food at the Friday picnic,
to make a pass at the coed of your choice, regardless of race, color or greed.



AN ABOMINATION

Mr. Ian Dono, Forestry, '47-'75
(graduation date unknown)

Engineers Week is a crool, sadistic and disgusting plot. It is designed soally for engineering arrogance and depravity. Engineers should not be allowed to continue hairassing us foresters like they have in the past.

E-Week is a fowl affair, designed to make us foresters look bad. For example, before the engineers started picking on foresters, they attacked mining students, laywers and architecture people. One year in the 1930s, the mining students got even when they turned a fire hose on the engineers parade. There were many brawls through the years, two. Recently, in 1972 Dean Cartrite was deluged with soap suds and confetti. In 1973, someone dropped styrofoam and water bombs on the E-Week celebration. But the engineers save their worst diseruptions for us foresters.

In 1970, they came along and cut down our foresters pole, just before foresters day. And it took us 94 years to grow it! This year, the engineers planted an ad in the Daily, saying that foresters day was cancelled! It was terrible--everybody believed the ad and nobody showed up. My pet beaver, Cuddles, was terribly disappointed.

What was worst was last years dance. What the engineers did was to brake into the fuse box at the lumber mill (where we were holding the dance) and cut off all the lights. Then, they sealed up the fuse box so that we could not get into it. We had to wait until the next morning, when the sun came out, to see what was going on. It was then that I found out that I spent the whole night dancing with an axe handle.

And I'm sure that this years E-Week will be more of the same, with you bunch of rowdy, lusty engineers trying to rag all over us foresters. Cut it out.

I remain, yours truly, I. Dono

Chemical Warfare 1940

The Technolog has published continuously since 1920. During this era, many articles and themes have been recurring over and over again. Here is a typical example of this. First, here is a reprinted article from a 1940 Technolog, describing in very scientific terms, the potential effects of poisonous chemical gases used in warfare. On the next three pages, there appears a current article, written in very human terms, describing the potential effects of poisonous gases on people during peacetime. Both these articles should make for interesting reading.

WHEN the Germans at Ypres in April, 1915 opened the valves on the chlorine cylinders to release the first cloud gas attack, they not only opened up a new and effective method of waging war, but they also produced a violently anti-German press campaign in the press of the world. They were described as being inhumane, barbaric, and unsportsmanlike for having used cloud gas against unprotected troops. The fact that the Allied troops were the recipients of the gas and that news to remote parts of the world as well as to the United States was controlled quite effectively by the Allies did not seem to enter into any of the considerations. Germany was judged as being inhumane and that was all there was to it.

It is difficult for the writer to consider any form of war to be humane. It was never intended that it should resemble a tea party. War has only one objective which is the complete submission of the enemy to the force of arms. Yes, there are treaties and rules governing the conduct of war, but any realist knows that these rules will be violated if violation will result in any real advantage. There was an agreement reached at the Hague Conventions of 1899 and 1907 outlawing the use of projectiles containing materials intended to obtain their effects primarily from noxious gases, but Germany had not used projectiles in the cloud attack. Furthermore, both the Germans and the French had used a sort of chemical grenade to which no objection had been raised because these were not particularly effective. No realist can expect a nation at war to refrain from using a weapon which may give it a decisive advantage over its enemies. The use of chemicals is no exception. A country situated as is Germany could not have been expected to do differently from what it did.

Chemicals in a form other than gun powder had been proposed, and in fact tried out prior to the World War, but so far as is known their use never resulted in any effective results. The use of fuming sulfuric acid appears to have been proposed during the Civil War, but United States military policy at the time prevented its being considered seriously. Chemical warfare as we know it today is generally considered to have started in 1915.

At the time of the World War, armies were becoming so strong offensively that the only effective means of defense which could be used satisfactorily was that of digging relatively elaborate trenches and holding to these positions. To take the positions required intense activity and was very costly in manpower as well as in ammunition and equipment. The machine gun, for instance, made it possible for one man to control defensively the area normally covered by large numbers of men equipped with individual rifles. In France the line of defense extended over the entire length of the country, and there were no flanks to be turned by the orthodox methods. An attack of any magnitude against a front which has depth is very costly and in most cases almost impossible to carry out successfully. None of the weapons available were doing the job of winning the war in the time believed to be necessary. The war was slowing down.

Gas as a weapon had one advantage not held by other weapons; namely, it was not affected by the laws of ballistics. It would under favorable conditions enter the entrenched positions of the enemy and drive them into the open, and the war could again become mobile. The British Intelligence Service apparently had word that something like a gas attack was to be launched against them, but they considered the possibility of gas to be too remote to consider seriously. They did nothing about it. When chlorine gas was used against the unprotected Allied troops, the entire picture was changed and frantic efforts were begun to do something about it. It seems to the writer that the most inhumane part of this gas attack was the failure of the Allies to provide something of a protective nature for the troops prior to the attack.

Defensively, the first efforts of the Allies were directed toward the development of a gas mask. Before the war ended, a very satisfactory mask was being used, but the present mask bears little resemblance to the wartime product. A gas mask effectively filters from the air all of the toxic components and makes the air safe for the wearer. It consists essentially of a felt cloth filter around a tin canister filled with charcoal and soda-lime which will remove all of the known toxic gases from the air and a conducting tube to carry the air to the mask which fits the face of the wearer. The facepiece or mask fits tightly over the wearer's head and makes normal breathing possible except for the added energy required to overcome resistance to air flow through the cannister. The army mask has been copied for use in industrial plants where gas hazards exist.

After the use of chemical agents was begun by the belligerents, it became necessary to work actively on the development not only of protective measures but also on new agents to be used against the enemy. The Allies did a large amount of work prior to the entry of the United States into the war, but in this country alone several thousand chemical compounds were studied for their possible application as war chemical agents. Approximately 50 to 60 of them were tried out in the field, but at the end of the war only a dozen were being used regularly. Approximately the same number are considered satisfactory for war use today. It is highly essential from a military angle that the number of agents be kept small. A soldier works under pressure of battle and he can use no reference library. He must think fast and accurately and then act equally as fast. A large number of agents would make this difficult, and it would also add to the supply and manufacturing difficulties which are always a problem in wartime.

Chemical agents are classified in various ways depending on the persons interested. The scientist groups them according to their physiopathological properties, physical properties, and their chemical properties. He must know something of properties of the agent which make it worth consideration as a war gas; he must know what its freezing point, boiling point, and volatility are; and in addition he must know the nature of its chemical properties so that he can estimate whether it can be used successfully under field conditions. The table lists the most common of the agents possessing satisfactory properties.

When the agents have been tested and considered from the scientist's point of view, the soldier must make his classification of them so that the non-technically trained man in the field may use them to the greatest advantage. He generally classifies them according to their effects on individuals and their effect from a tactical

TABLE OF MILITARY GASES

Agent	Military Symbol	Chemical Formula	Effect Classification	Tactical Classification
Mustard Gas	HS	$(C_2H_4Cl)_2S$	Vesicant	Persistent
Phosgene	CG	$COCl_2$	Toxic	Non-persistent
Chloracetophenone	CN	$C_6H_5OCH_2Cl$	Lacrymator	Non-persistent
Chlorpicrin	PS	CCl_3NO_2	Irritant	Semi-persistent
Diphenylamine-chlorarsine	DM	$(C_6H_4)_2NH_4AsCl$	Irritant	Smoke
White Phosphorus	WP	P	Smoke	Smoke
Chlorsulfonic Acid		$HClSO_3$	Smoke	Smoke
Titanium Tetra-chloride	FM	$TiCl_4$	Smoke	Smoke
Thermite	Th	$Al+Fe_3O_4$	Incendiary	Incendiary

point of view. He also simplifies their use by assigning them simple symbols by which they may be identified and referred to in the field. These symbols, as they are used in the United States army, are given along with the names of the agents referred in this article. It may be difficult for the reader to guess at the derivation of the symbols used but, in general, they came from names applied to the agents during the World War. An abbreviated list of classifications according to their effect should include:

Smokes, agents used essentially to screen the activities of friendly forces from the enemy. Navies have employed smoke screens for a long time to assist ships in their maneuvers. The smokes employed by armies have been produced by white phosphorus (WP), titanium tetrachloride (FM), and chlorsulfonic acid.

Incendiaries, agents intended to produce fires. They include thermite (Th) and white phosphorus (WP).

Toxic Agents, those which cause death, or serious impairment of bodily functions when an individual comes in contact with them. Many compounds are toxic, but all are not suitable for war purposes; those which are considered best at present include such agents as phosgene (CG), mustard gas (HS), diphenylamine-chlorarsine (DM), chlorine (Cl), and many others.

Irritants, gases that irritate the respiratory trace or the lungs. Most agents are irritants and good examples of those employed are diphenylyaminechlorarsine (DM), mustard gas (HS) and chloracetophenone (tear gas) (CN).

Vesicants, gases that produce blistering of the skin; mustard gas (HS) is the best example.

Lachrymators, agents which cause severe irritation of the eyes and hence temporarily remove the affected individual from action. The most popular tear gas is chloracetophenone (CN).

In addition to knowing the effect of a given chemical agent on an individual, the soldier must know something of its physical properties in a way that will make it possible for him to use the agent in a tactically effective manner. He makes an additional classification into smokes, non-persistent agents, and persistent agents. The man in the field then knows that a smoke may be used for screening purposes, and that a non-persistent agent is one which will not remain on the target for any great length of time. Both of these types of agents may be used offensively because they will be clear of the area by the time friendly troops arrive. The persistent agent, on the other hand, will remain on the target for long periods of time and deny access to the area by both sides. The persistent agents are, strictly speaking, not gases, but are usually liquids or solids. They have great usefulness in infecting areas which the enemy must cross if he is to annoy friendly troops, and they may be used offensively in neutralizing spots which are difficult to occupy and which friendly units need not enter.

Persistent agents may remain in the area to which they are applied from a few days to weeks, whereas non-persistent agents generally clear from the area in a few hours. Persistent agents must be generally avoided because those like mustard gas act effectively by contact with the skin. Non-persistent agents can generally be protected against by the gas mask. The table lists the common chemical agents and gives their classifications. This list is not complete, but it gives examples of each type of agent and includes the most important of the agents now considered for war use.

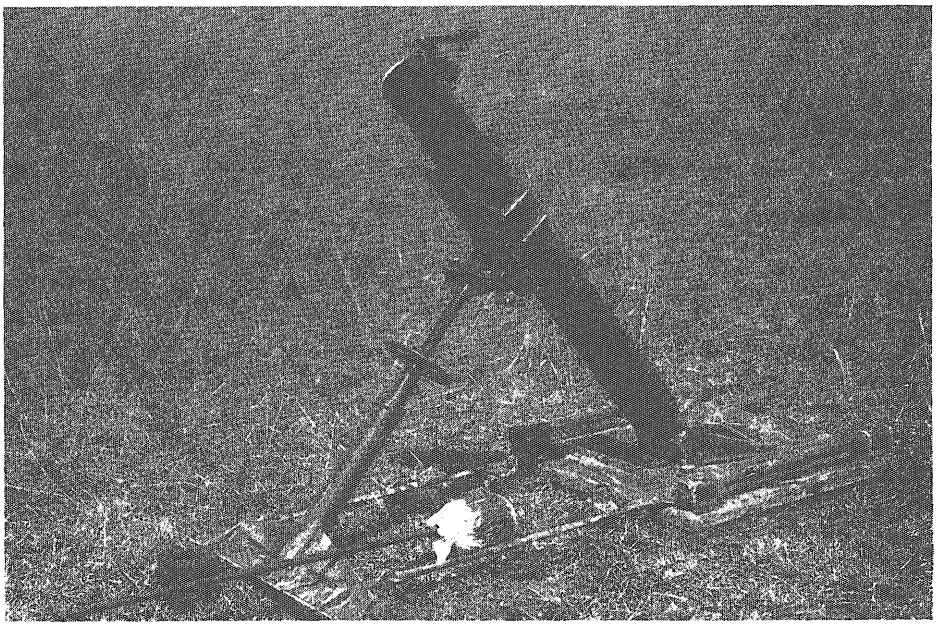
What advantages does chemical warfare have? Well, it is humane; although it produces a large number of casualties, the deaths due to gas have been shown to be lower than for gunshot casualties. Prentiss, in reviewing the records of the World War, gives data on the use of chemicals compared with other weapons. Complete data are not available for all nations involved in the war, but for the United States forces there were a total of 224,089 casualties from all causes of which 13,691, or about 6.1 per cent, died. Gunshot wounds produced 74,883 casualties of which 7,474, or about 10 per cent, died. Chemicals produced 70,552 casualties of which 1,221, or about 1.75 per cent, died. Thus a chemical casualty had about six times as good a chance to live as did a gunshot casualty.

Casualties without deaths are of advantage to the side producing them because a casualty who does not die has to be taken care of by men who might otherwise be added to the fighting forces.

From the purely tactical point of view, persistent chemicals have the advantage that they remain on the target after being fired, and therefore can be put down during the night, saving the guns for artillery fire prior to the attack in the morning. Troops forced to use masks are not so mobile as those who are without them. The mask requires effort to breath, and one cannot exert himself very much while wearing a mask. Also, it is extremely harassing to troops to be continually checking for gas masking and unmasking.

Chemicals do have some disadvantages which are not characteristic of other weapons. The principle one is weather. No gas attack can be successfully launched in a high wind or when the wind is not favorable to friendly troops. In this respect it is not dependable and makes it difficult to plan operations, the success of which depends on chemicals. After considering the disadvantages and difficult qualifications and death statistics for gases, they do not seem to be such a potent weapon as is generally believed.

A 4.2-inch chemical mortar.



Conscience and CRISIS

by Tom Coughlin

Nerve gas is one of the most deadly weapons in the arsenal of the United States Army. A single small drop on the skin of a human will cause instant paralysis and inevitable death. A few pounds of nerve gas can annihilate a large city just as brutally as a nuclear bomb. Considering the deadly potential of nerve gas, the Army presumably uses all the cautions it can when handling it. But according to a story which unfolded in 1969, this is a false assumption.

In April, 1969, as a result of a series of reports by the newly formed **Colorado Committee for Environmental Information** (CCEI), the Army proposed to transport the 27,000 tons of poison gas by rail to New Jersey. There it would be loaded on old Liberty ships, towed out to sea and sunk. United States Representative McCarthy of New York, quite by accident, found out about this shipment. He had first become seriously interested in Chemical and Biological Warfare (CBW) when he and his wife watched the NBC television "First Tuesday" documentary on the subject. McCarthy said later that he was shocked by what he saw, and when his wife asked him what he knew about CBW, he had to admit his ignorance. In the coming months, McCarthy set out to learn more about the United States' CBW program. When he learned of the proposed transcontinental poison gas shipment, McCarthy sought the advice of the Harvard biochemist, Matthew Meselson.

Meselson had been concerned about the issue of CBW since his graduate school days but he was slow to get excited about the proposed shipment. When McCarthy first contacted Meselson he was told that if the shipment only involved relatively non-volatile substances, like Mustard Gas, there should be little danger if reasonable precautions were taken.

McCarthy decided to raise a public alarm, however, when he and Meselson became aware of the scope of the Army's plans. The shipment was to consist of some 800 railroad cars filled with 27,000 tons of poison gas weaponry from the Rocky Mountain Arsenal and other munitions depots, including 12,000 tons of lethal GB nerve-gas bombs, 2,600 tons of leaking GB nerve-gas rockets enclosed in concrete and steel "coffins", and 5,000 tons of Mustard Gas. Each railroad car would carry enough poison gas to wipe out several large cities. The Army's proposed emergency medical preparations consisted of a few medics on each train, ready to spring out in their rubber suits at a moment's notice, to administer atropine to everybody in sight. Considering the quantity and rapid toxicity of the nerve gas, such measures are ridiculously inadequate.

The danger would persist even after the gas reached port and was towed out to sea. The Army had already dumped a large quantity of munitions, including some less toxic gas weapons, as part of it's **Operation CHASE** (Cut Holes and Sink 'Em). The dumping operations proved to be not without incident. One CHASE ship broke loose while being towed to the intended dumping place, and another blew up only five minutes after sinking--apparently as a result of shifting ammunition.

The disclosure of the movement operation resulted in such a general furor that the Army was forced into announcing that the shipment would be delayed pending a full investigation by a National Academy of Science (NAS) scientific panel. Frederick Seitz, at that time both president of the NAS and chairman of the defense department's top science advisory committee, the Defense Science Board, volunteered the services of the NAS for this purpose. To head the special NAS panel, Seitz appointed the famous Harvard chemist and explosives expert, George Kistiakowsky, who was NAS vice-president and a former science advisor to President Eiesenhower. Kistiakowsky insisted on appointing his own panel. One of Kistiakowsky's appointees was Matthew Meselson.

As a panel member, Meselson was able to visit the Rocky Mountain Arsenal and found that the technicians there had already accumulated considerable experience in dismantling and detoxifying the nerve-gas bombs. They were confident they could handle all 1.6 million bombs. Further investigation revealed that the Army had previously appointed an advisory committee to look into the disposal of nerve gas. This committee had recommended that the gas be disposed of on site at the Rocky Mountain Arsenal. Despite this advice, the Army brass had quickly agreed to move the nerve gas when it became an issue in the Denver mayoral election due to the alarm raised by the CCEI.

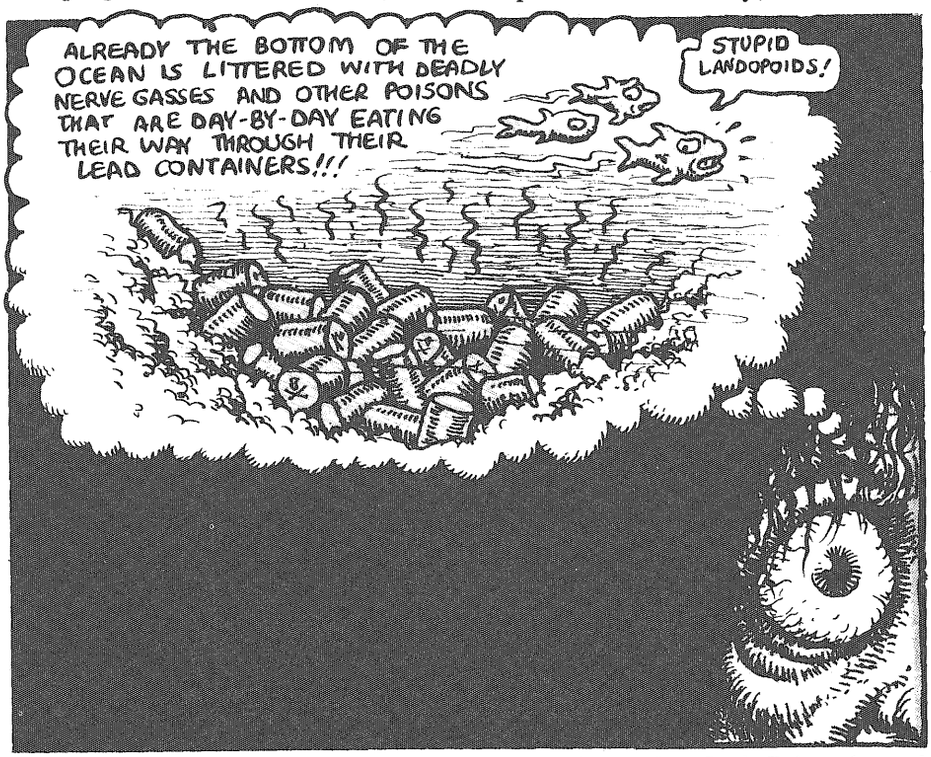
The NAS scientists pointed out the danger of transcontinental rail trans-

port of explosives, pointing out the large number of unmarked railcrossings in New Jersey, as well as the recent history of frequent derailings of dangerous cargoes. They also pointed out, in meeting with the Army officials, the possibility that the excellent acoustic coupling provided by water could cause a massive simultaneous explosion of the nerve gas bombs when the ship upended as it began sinking. The panel members remarked as well that there was a great danger due to loose equipment falling on the bombs also causing such a chain reaction. The prevailing winds could then carry the resulting poisonous cloud the hundreds of miles from the proposed dumping site to New York City and the eastern seaboard. Even if this were not to occur, however, the gas would poison a large volume of the ocean.

The NAS report was released on 25 June, 1969. Two days later, the Army announced that it had agreed to burn the Mustard Gas and detoxify and dispose of the nerve gas bombs at the Rocky Mountain Arsenal, as was recommended in the advisory report rather than shipping them across country. The leaking nerve gas rockets could not safely be dismantled and detoxified and they were eventually dumped at sea off the Florida coast.

All seemed to be hunky-dory concerning the Army's actions on the disposal operations until June, 1973 when the mayor of Denver inquired in Washington as to why the Army had reneged on it's offer to give the city land from the Rocky Mountain Arsenal for a new runway. He discovered that disposal of the arsenal's nerve gas had not even begun. Confronted once again with outraged citizens, the Army promised to begin destroying the gas in October, 1973.

This example of the nerve gas shipment controvercy, which was drawn from the Joel Primack and Frank von Hippel book **Advice and Dissent**, demonstrates many of the characteristics of the government's approach to acting in technically related issues which concern the public's welfare. A situation exists which is a potential hazard to the public welfare (i.e. open storage of obsolete CBW weaponry), this issue is brought to the attention of the citizenry by an independent scientist -citizen or a group of scientists and concerned citizens (here the CCEI). Their news releases and political research activities then raise a general public alarm which forces the affected government branch to re-evaluate it's position and set up study panels to review the situation and make a recommendation. As often as not, their recommendations are ignored by the government in favor or more esoteric or political considerations. This occured repeatedly to the recommendations given to the Johnson and Nixon administrations by the President's Science Advisory Committee (PSAC) and the National Academy of Science's National Research Council (NAS-NRC) concerning the dangers of various pesticides, such as DDT, the commercial feasibility of the SST, and the political expediency and defensive usefulness of the proposed ABM Safeguard and Sentinal missle systems. These reports and recommendations are usually brought into the open only due to the action of interested citizens who serve on these study groups or as a result of group action by independent agencies such as the Colorado group. Finally, even after the government has been prompted into publically committing itself to action it is often slow to impliment it's promises and requires constant observation and investigation to see that it keeps it's word.



The individual citizen plays a predominate part in all of this. It is due to the action of people like Matthew Meselson in the nerve gas shipment issue, Rachel Carson in the persistent pesticide (like DDT) issue, and Dr. William A. Shurcliff on the SST issue, that we owe much of the public's awareness of these issues.

The action of individuals usually leads to the formation of public action groups or the utilization of already existing groups, like Nader's Raiders, The Council for a Livable World, or the Federation of American Scientists. These groups then carry on the confrontation in public forums, independent research and experimentation, press releases, lobbying, letter-writing campaigns and discussion with aides and major

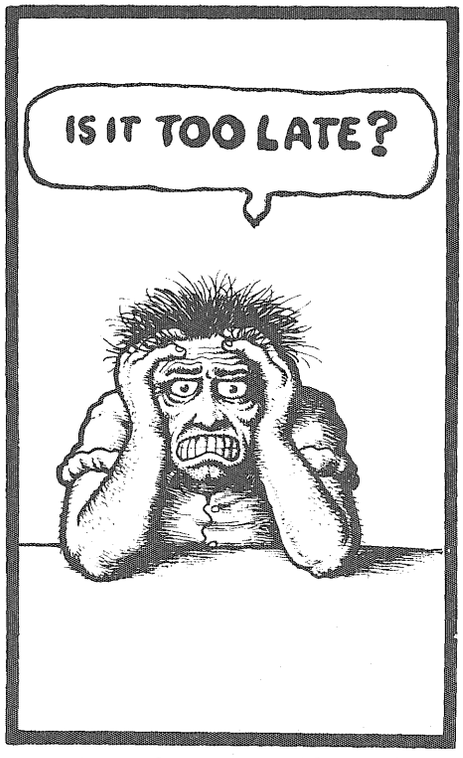
political contributors. They serve a purpose of informing the public and raising the necessary funds for continued action that an individual would find difficult to emulate. This group is able to carry on the long range politics and research activities required to prompt government agencies to action and then to make sure that commitments once made are kept. They can also, if not institutionalized into rigidity, serve as sounding boards and supporters for future issues.

Just as individual researchers are important in insuring that the public interest is kept in mind in governmental decision making. It also seems reasonable to assume that governmental advisory groups must not be limited to only the executive branch. The legislative branch of government must have it's own scientific advisory system in order to preserve the balance of powers. Also, as we have observed, the executive branch is often unresponsive to it's own technical advisors, just as it was to the PSAC before it was disbanded in the early 1970's. The Congress, however, is more a public forum and could serve the people best only if kept well informed on technical issues by outside sources, since the legislative branch does not contain many scientists and engineers.

Congress did not have such an organization for it's own technical assessment, however, until the **Office of Technology Assessment** (OTA) began operating in late 1973. The OTA was established to undertake the study of major unresolved technological issues confronting Congress, and initiate research to be performed by university or private organizations under the supervision of the OTA staff.

The courts and state governments have also made important contributions in the dispute over environmental issues, as in the DDT and persistent pesticide controversies, by setting important precedents. Often, litigation can serve the purpose of causing serious consideration of the issues. To achieve results, it is probably best to avail oneself of all forms of political and social action ethically and legally available.

Laurence Yarosh in his article **Scientific Integrity** points out the problem of biased or bought scientific opinion and research. He uses as an example the conflicting testimony of experts employed by each side in the Reserve Mining controversy and the 1913 Philadelphia utility rate rollback issue where Dugal C. Jackson, a former professor



at MIT and past president of the American Institute of Electrical Engineers, was accused of producing a misleading evaluation of the utility company's expenditures.

A charge of biased or inexact research is perhaps the most ominous criticism that one can make of a researcher's work, but it is conceivable that a man who is under pressure by his employers and threatened with expulsion might well sacrifice his honesty. More often than not, however, a scientist is made to keep silent by security measures more than by employer threats. In the case of the SST, ABM and persistent pesticide issues revealing reports were not released to the public, except via leaks and unsolicited and personally dangerous statements by solitary researchers and panel members until long after the issue has cooled off.

The university scientist is more independent than one employed by industry. Technically, his job is not endangered by his merely expressing an unpopular opinion or pushing for touchy conclusions which are often politically embarassing. In actuality, the fate of the scientist-activist is more like that portrayed by Bertrand Russell.

"As the world becomes more technically unified, life in an ivory tower becomes increasingly impossible. Not only so; the man who stands out against the powerful organizations which control most of the human activity is apt to find himself no longer in the ivory tower, with a wide outlook over a sunny landscape, but in the dark and subterranean dungeon upon which the ivory tower was erected...It will not be necessary to inhabit the dungeon if there are many who are willing to risk it, for everybody knows that the modern world depends upon scientists and, if they are insistent, they must be listened to."

It is important that even a man who does not follow somebody else's drummer be not alone. Without an interested and responsive audience of his fellows, the scientist-citizen becomes a solitary figure. This is the importance of public interest science as an established practice of individual scientists and scientific organizations.

There are several scientists now employed by public interest groups, some organizations employ almost as many scientists as lawyers. It is important that these organizations become recognized and that universities and professional societies come to support, or at least cease to discourage, their members who engage in public interest activities. For a scientist is neither a lawyer or a doctor who is bound by oath to protect the privacy of his clientele. Rather, he is, or should be, a citizen interested in the search for knowledge and the public welfare.

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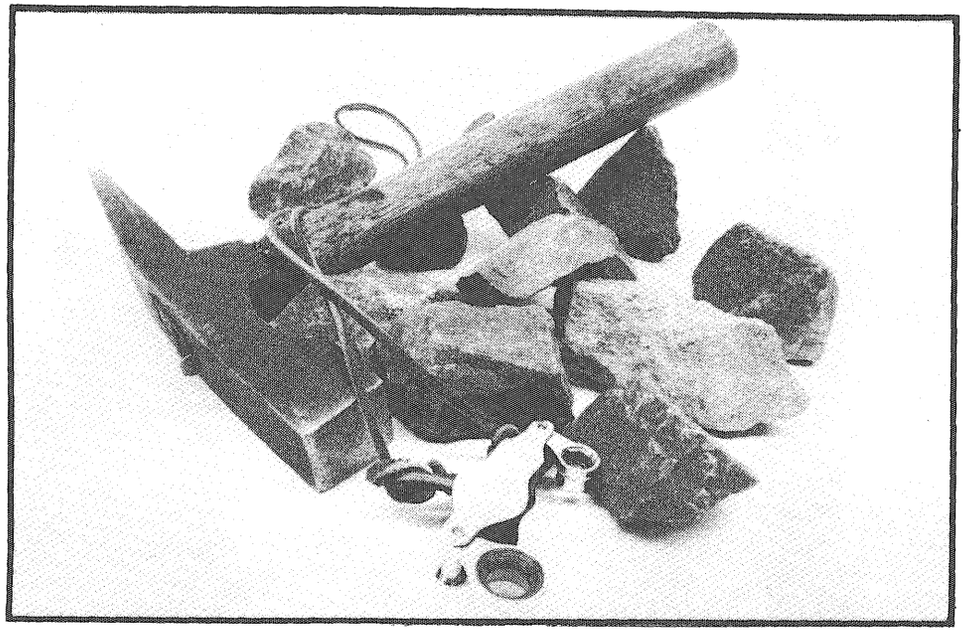


by Jack Rink

The job opportunities for mineral engineers in this state are outstanding

A quick glance at today's headlines is enough to frighten prospective job hunters. With an unemployment rate of over eight per cent , talk of hiring freezes has brought about cutthroat job competition in many fields. However, in at least one area, potential jobs outnumber candidates by as much as 10 to one. That area is mineral, or mining, engineering.

The recession has yet to hurt any graduates of science or technology programs. But if the demand for engineering graduates remains excellent, the interest in mineral engineers will be nothing less than phenomenal.

Some idea of the concern now shown by certain industries about the lack of mineral engineers can be seen by the scope of their campus recruiting. Last year, Consolidated Coal Company was so concerned at the lack of mining engineers that they, alone, interviewed 80 percent of the nation's 200 or so graduates in the field. Fully 60 percent of the graduating mining engineers were offered jobs by that single company.

There are many reasons behind this lack of trained mineral engineers ranging from obvious economic factors to complex social considerations. The energy crunch and the resulting national drive towards resource self-sufficiency is certainly the major cause of the interest in mineral engineering and related fields. However, lesser but still significant factors have also contributed to the present demand.

Not only national interests are affected by the mining engineer shortage. A vital regional concern is the possible effects the shortage may have on the mining industries of Minnesota. Another local aspect of the situation is how the University is planning to meet the expected consequences of the shortage.

To understand the total story of mineral engineering, it is necessary to dissect a complicated web of causes and implications of the present shortage of mineral engineers. The best place to start is probably with the extent of the shortage.

In comparison to other professions, "Engineers are less affected by the recession," states Leroy Ponto, Director of the I.T. Placement Service. According to figures compiled by Ponto and his staff, the overall I.T. placement rate remains at an impressive 85 to 90 percent. The Placement Service even reported a 30 percent increase in the number of companies making visits to the campus at the beginning of the school year. Although this trend has slowed somewhat, a reasonable conclusion would be that regardless of the economy, few companies are willing to risk technical stagnation by skimping on their scientific staff.

In this high demand/low supply market, mineral engineers seem to be the hottest item. Placement Service figures on the last graduating group of mineral engineers are limited, but are representative of the national situation. Only 6 out of the 10 graduates returned questionaires, but all those were employed with an average starting salary of $1,084 a month. Other figures, kept since 1970 by the Mineral Industry Education Fund, show that every graduate of the mineral program has been placed since that time.

Still another indication of the present interest in mineral engineers is shown by the current pay scale

figures. According to the results of a survey published in February, the median annual salary for mining engineers is now $20,600. This is the fourth highest rate of the 22 categories of engineers listed.

The energy crisis is the single most important reason for the current demand of mineral engineers. While the chain of discovering, producing and efficiently utilizing new sources of petroleum and coal has created opportunities for all facets of science, the first vital link is the mining engineer.

The shortage of trained mineral engineers that is helping to compound the energy crisis did not occur instantaneously. Certain far-sighted companies and individuals saw the shortage developing 10 or more years ago. Apparently a lack of communication and general public disbelief that the world could ever be caught in an energy squeeze caused much of the current problem.

> The energy crisis is the single most important reason for the current demand of mineral engineers.

Professor Charles Fairhurst, head of the Department of Civil and Mineral Engineering, speaks of "the frustration of the time it takes to convince people there is a real need. It is like watching a storm on the horizon--you see it coming, but there is nothing that you can do about it." Fairhurst went on to point out that development of mineral resources will also require trained engineers in related fields, such as civil engineering.

Professor Fairhurst also feels that until the effects of the energy crisis were felt by the public, mining engineers suffered from an acute case of a bad public image. While admitting that the mining and petroleum industries have committed their share of injustices, Professor Fairhurst believes that the press has over-played the negative effects of such practices as offshore drilling and strip mining, while not reporting the essential roles that raw materials play in the American economy.

The resulting public disenchantment with mineral industries leads to both a lack of student interest in mining engineering and political opposition to further mineral research and development. This has probably caused a significant part of the problem, Fairhurst concludes.

Michael Pojar is a graduate student working on his PhD in mining. He is also the Director of the Mineral Industry Education Fund (MIEF), an organization designed to disperse information about Minnesota's mineral industries and to encourage communication between schools and industries. In addition, last year MIEF spent $27,300 on various loans and grants to 37 students presently studying mineral and geological engineering.

Pojar agrees that the energy crisis is the overriding factor in the shortage of mineral engineers, but feels that it is part of a more general attitude that the United States should become self-sufficient in a wide variety of raw materials, for which the country is currently depending on foreign markets. "All of a sudden, the natural materials we use are in the limelight," says Pojar.

Another concern Pojar has is that major universities, including the University of Minnesota, have not done all they could do to support mining schools--an opinion shared by some national authorities interested in the field. Much of their argument is based simply on the number of schools training mining engineers. Today, only 18 schools train a total annual graduating class of 200 to 250 engineers.

Declining enrollments and a large demand in foreign markets has put a further strain on the limited number of qualified engineers. Last year, for example, South African recruiters reportedly were in the United States offering employment to any mining engineer who would listen. The whole situation adds up to a strong seller's market for a mining engineering diploma for many years to come.

Could the market conceivably swing around and leave later generations of mining engineers with unwanted skills? Apparently not in the foreseeable future.

Leroy Ponto of the Placement Service notes that mining engineers comprise less than two percent of the total number of engineers in the country. With such a small number of engineers engaged in primary production, Ponto concludes, " the demand can take the supply for many years."

Michael Pojar and Professor Fairhurst point out the fact that practically all of our essential raw materials are initially mined. The two also compare mining to farming since both deal with converting the earth's potential resources to products useful to man. As Professor Fairhurst sums up, "Farming and mining will always be with us because they deal with natural resources." With that in mind, Fairjurst feels that the possibility of a future oversupply of mining engineers does exist, but is remote.

There is seemingly complete agreement that mineral engineering has a promising future--state, nation and world wide. The reason is basically that man is trying to develop the world's finite resources fast enough to meet the exponential increases in population. As Professor Fairhurst says "there is a broad, long range resources problem that will not go away."

The role of mineral engineering in Minnesota will continue to grow and will be increasingly important to the economy of the state. A report prepared by a University committee on the mineral program mentions at least six presently or potentially valuable resources in the state. In order to be fully developed, mining engineers will be required. These resources are magnetic taconite, semi-taconite, copper-nickel, manganifetous products, peat and aluminum. In addition, both private and governmental environmental agencies will need trained engineers to enforce mining safeguards.

> "the demand can take the supply for many years."

Three of these areas have already projected what their immediate requirements will be. If copper-nickel mining is allowed in the state, 50 mining engineers will be required in a seven year period. The taconite industry expects to need 30 engineers for each of the next five years, while the Department of Natural Resources will be looking for 19 engineers during the next three to

five years.

On the national scale the projected opportunities look much the same. The coal industry, basking in renewed attention, would gladly hire every graduate of mining schools. Petroleum and hard-rock mining companies are at the point of being limited in total growth by a lack of qualified mineral engineers. A mine inspection bill, pending in Congress, could create an instant requirement for 1,200 mine inspectors. The list could go on almost indefinitely.

At the present time, the Mineral and Geological Engineering program at the University has a total of 57 undergraduate students enrolled. This number is up from a low of 20 students in 1967, but does not approach the peak enrollment of over 220 in 1948. The enrollment does appear to be in the early stages of an upswing.

Despite it's current small size, the Mineral Engineering program , formally known as the school of Mines and Metallurgy, has made important contributions to the science of mineral engineering. One particularly noteworthy example was the work of Fred A. Davies, who was a recipient of the University's Outstanding Achievement Award. Davies is credited with the discovery and development of the first Saudi Arabian oilfields. He eventually became president of what is now the Aramco Oil Company.

Closely related to the department is the Mineral Resources Research Center (MRRC). Established in 1911 as the Mines Experiment Station, the MRRC was formed to promote the development of Minnesota's mineral resources.

Until last year the MRRC was a blend of state and privately financed research coupled with graduate and undergraduate instruction. The employees of the Center taught on a part-time basis and were paid pro-rated salaries by the University. The research and development activities of the Center were financed by both private and state funds.

The MRRC formerly operated on a budget of about $500,000 a year, $250,000 of which was state money. However, in July of 1974, state aid was cut off. Since then, the MRRC has run with only a skeleton staff. The primary reason for the withdrawl of state funds seems to be a feeling that state money should not be used to finance research that will directly benefit private corporations.

Supporters of the MRRC point out that research done by the Center has been responsible for much of the development of Minnesota's resources. The resulting state income from this development is many times greater than the amount originally invested. The best illustration of this view is the taconite concentration technique. Proponents of the MRRC are quick to point out that the technique, perfected at the Center, is now the basis of an industry that adds over $1 billion annually to the state economy.

A University committee recently released a report suggesting how the University should deal with the changing fortunes of the Mineral Engineering Department. The report made two important proposals.

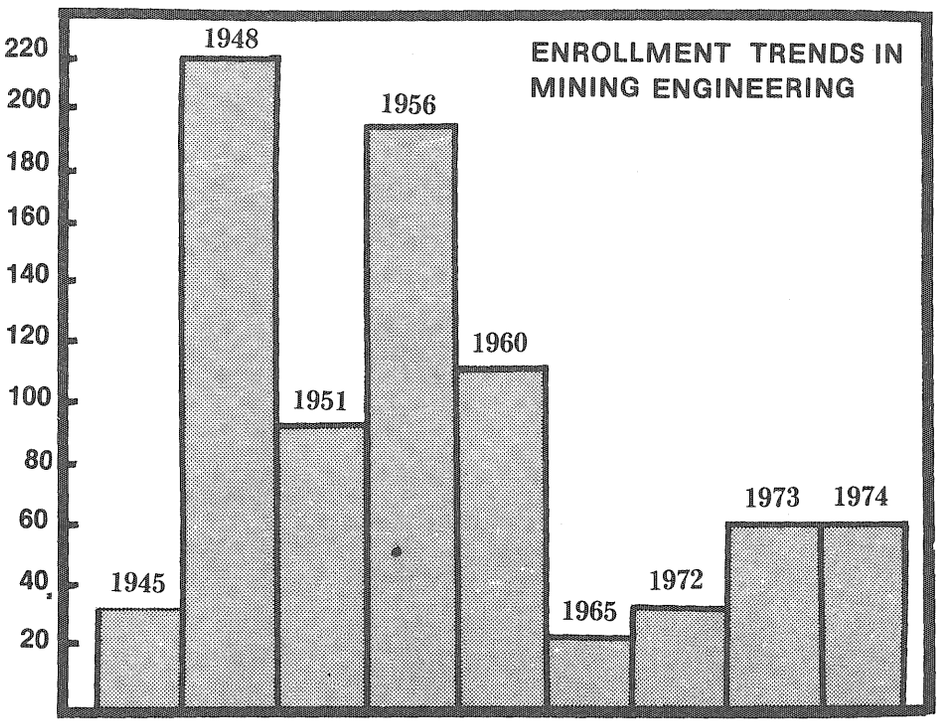
First, the report encouraged the development of a trial program allowing mineral engineering students to spend their first three years of study at the Duluth campus. The major advantage of this arrangement would be to locate the mineral and mining program closer to the most important mining region of the state. This would make it possible for students to actually observe mining operations and perhaps receive some type of on-site training.

The second major suggestion of the report was to resume funding to the MRRC. Quoting directly from the report, "A Center research staff with a more broadly based set of interests and acting as a part-time faculty would complement the present faculty in the mineral and geological engineering program to offer a more balanced educational program in this discipline on the Twin Cities Campus."

It is estimated that the proposed three year program on the Duluth campus would require an initial investment of $45,000 for equipment plus $39,000 to $55,000 annually for salaries and expenses. The report also asks that the MRRC be "funded adequately", a phrase which presumably translates into, roughly, $300,000 a year.

Even with such large financial requests, the report has already received quite a bit of support. University of Minnesota President C. Peter Magrath, many business leaders and several newspapers have already endorsed the report and it's conclusions. Whether the state legislature greets this request for more money as warmly is a different matter.

The mineral engineering program has great potential for growth. The strong demand for graduates along with the valuable opportunities for practical experience provided by the MRRC and the state's mining industries could provide the basis for a relatively large and vigorous program. If the program receives the monetary support necessary to expand and improve, then its success is virtually assured.



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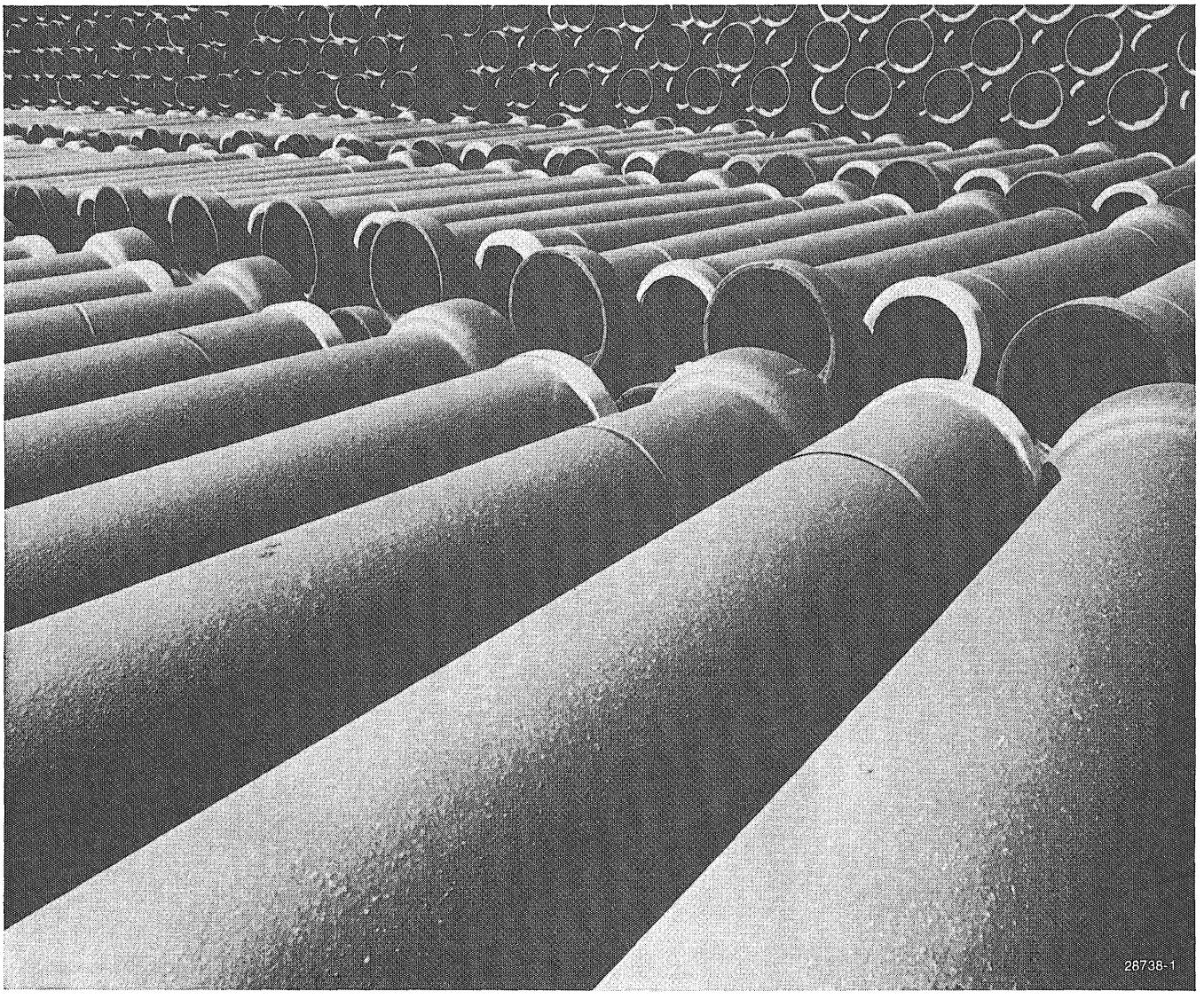

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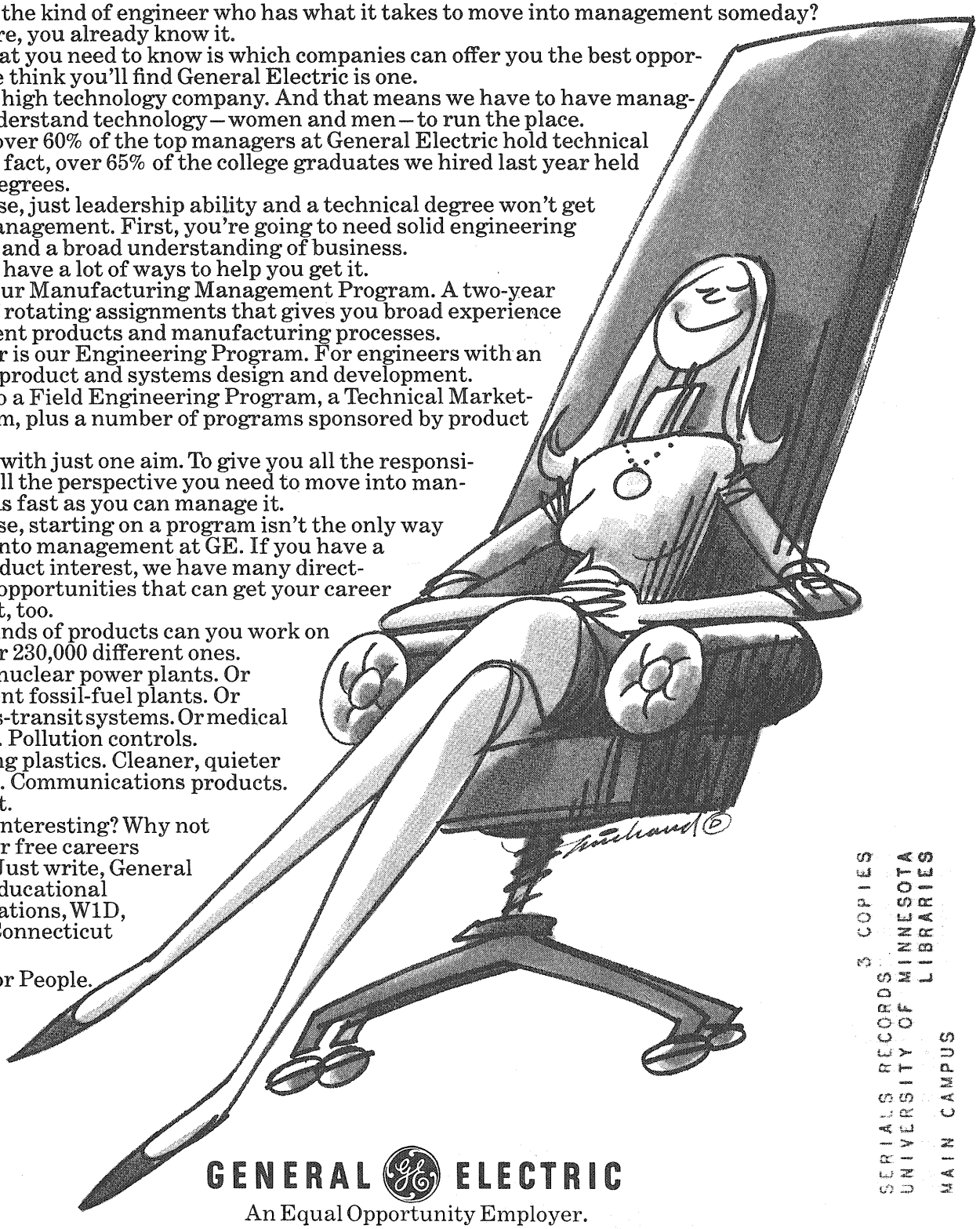

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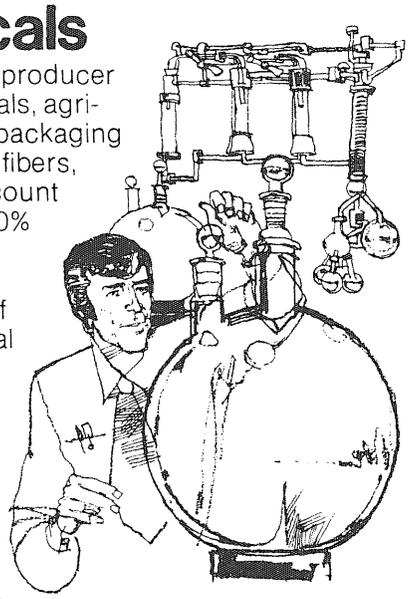
FMC's business is machinery and chemicals, a combination which gives the company two billion dollars annual sales. And an unusual depth of capabilities in such fields as energy, food production, municipal services, construction, materials handling, and transportation.

This wide variety of opportunities generates a need for an equally broad variety of professional skills, from business administration to major fields of engineering. Here are three examples:

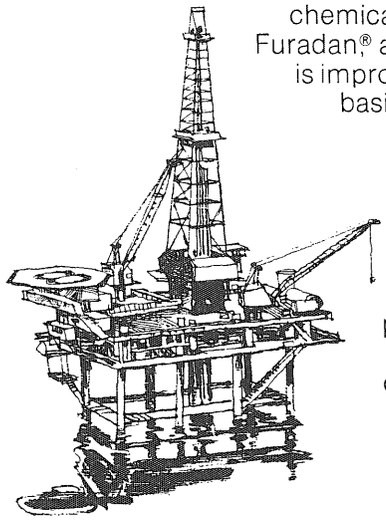
Chemicals



FMC is a major producer of industrial chemicals, agricultural chemicals, packaging film and man-made fibers, which, together, account for approximately 50% of the company's dollar volume.

An illustration of how FMC's chemical and machinery capabilities work in combination is agriculture. FMC designs and builds automatic equipment for cultivating, planting, and harvesting, manufactures chemicals to protect the crops, and mechanized sprayers to apply the chemicals, and packaging films to protect the products.

FMC has developed numerous proprietary chemical products, such as Furadan®, an insecticide which is improving yields of many basic crops throughout the world.

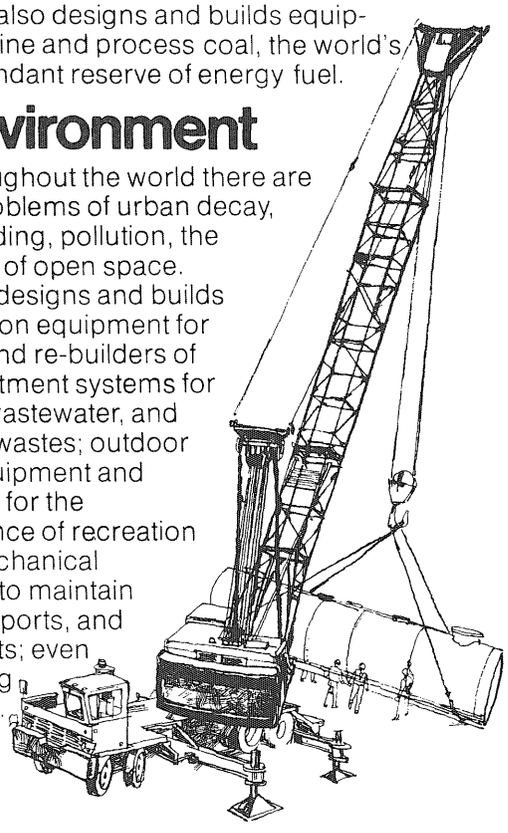


Energy

With the intensifying effort to recover more of the world's petroleum reserves, there is growing demand for a broad line of petroleum specialty equipment which FMC designs and manufactures. The products range from wellhead flow controls, swivel joints, and valves to mechanized loading systems and ocean-going vessels.

FMC also designs and builds equipment to mine and process coal, the world's most abundant reserve of energy fuel.

Environment



Throughout the world there are urgent problems of urban decay, overcrowding, pollution, the shrinkage of open space.

FMC designs and builds construction equipment for builders and re-builders of cities; treatment systems for sewage, wastewater, and industrial wastes; outdoor power equipment and chemicals for the maintenance of recreation areas; mechanical sweepers to maintain streets, airports, and parking lots; even fire-fighting apparatus.

The opportunities

These examples suggest some of the varied opportunities this company offers for self-realization and self-achievement.

FMC is solid, successful, and has been profitable throughout the 47 years of its corporate history. Because it is involved in growth markets, it provides many opportunities for its people to grow with it in their individual capacities.

And to contribute solutions to some of the most urgent problems of our time.

If this sounds like the kind of work life you could enjoy, see the FMC representative on campus, or write for further information.

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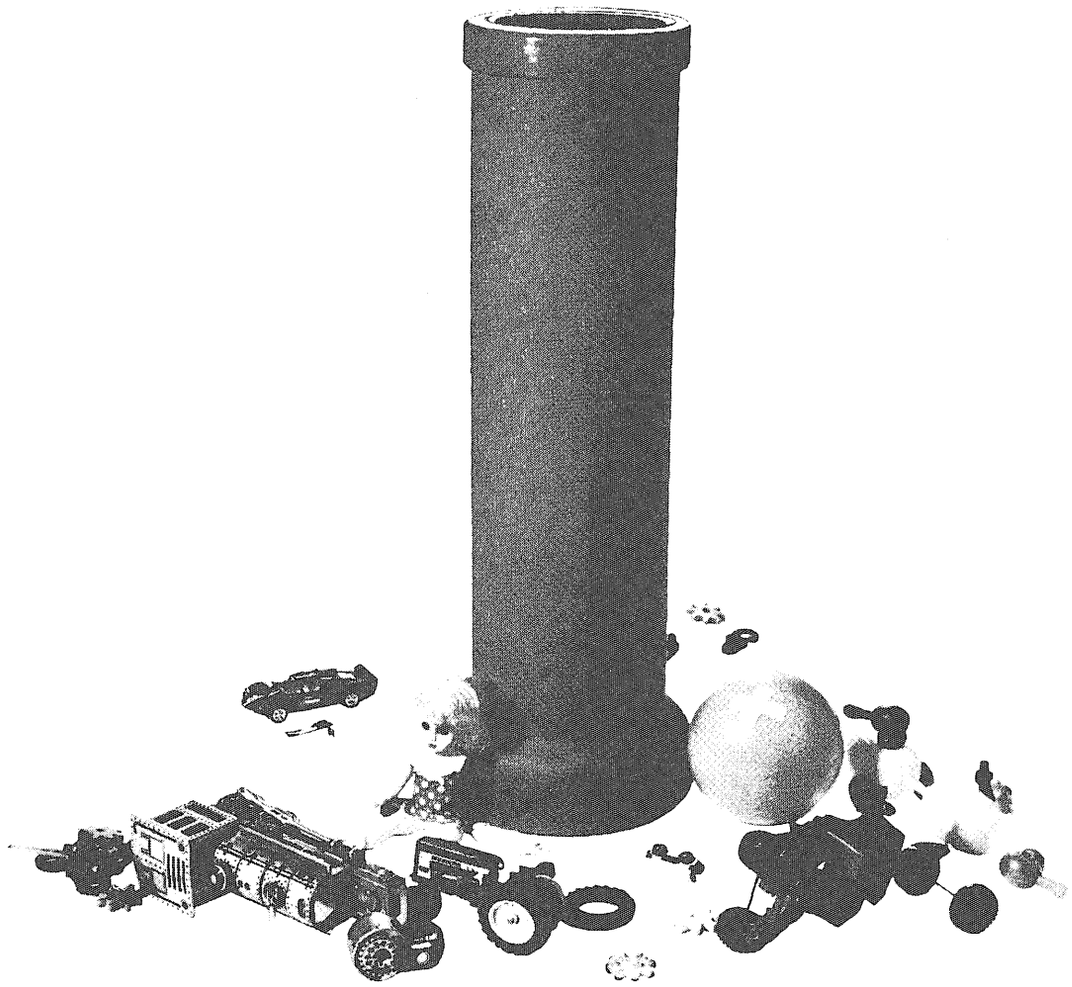
FMC



In today's plastic world, it's nice to know there are still a few dependables.

Every material has its use. But something that's good for one use isn't necessarily good for another.

Some sewer pipe materials shouldn't be used in sewer pipes. They lack the structural characteristics found in a dependable sewer pipe system. They have minimum resistance to rot and roots. Deflection under load which can cause stoppages and eventual collapse. Thin walls susceptible to puncture. And weakness when exposed to high temperatures.

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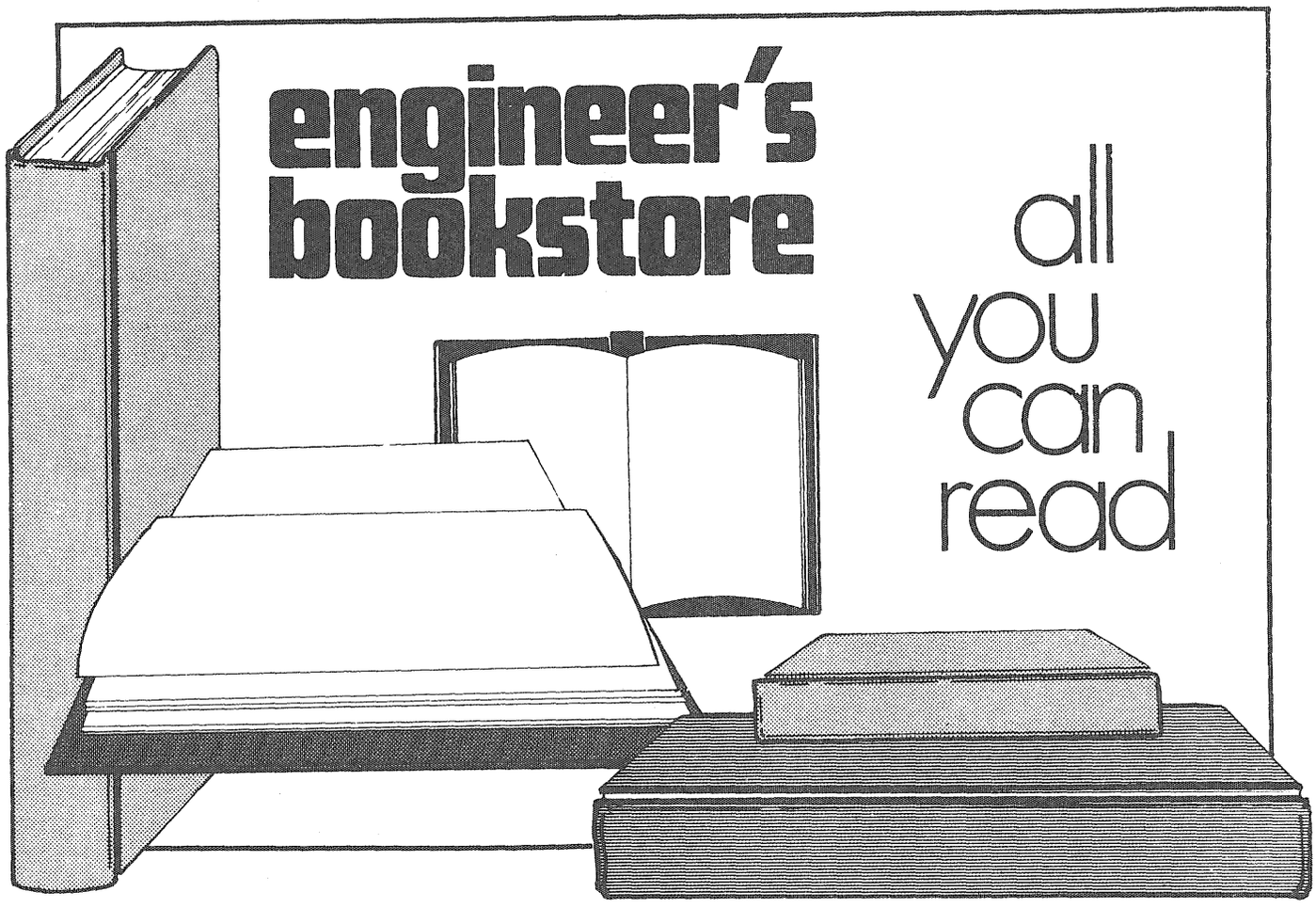

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minnesota **Technolog** spring² 1975

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Cover design by Bertil nielsen

Vol.55, No.6

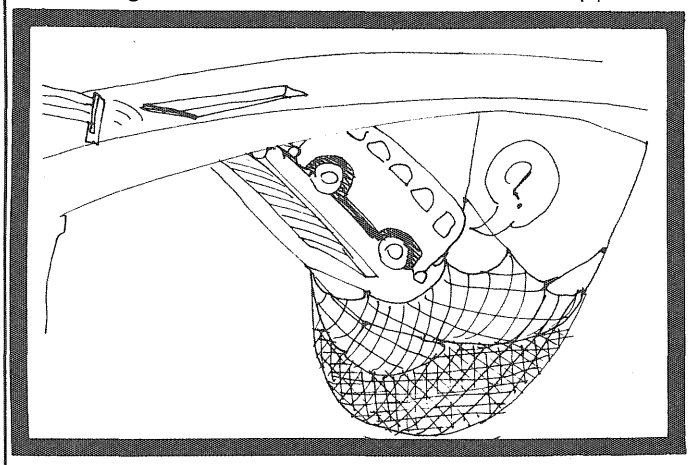
Technolog editorial pages

CATCHING A BUS--OUR FOUR PROPOSALS

Mass transit in the Twin Cities consists solely of buses, and buses pose grave problems for commuters. Mainly, there never seems to be a bus when you need one. More importantly, you must first transport yourself to where the bus deigns to stop and pick you up. So the major problem with mass transportation seems to be in catching a bus. With this in mind, the **Technolog** pooled it's resources in order to get our Art Director, Kevin Strandberg, ripped. While under the influence, Mr. Strandberg came up with four first-rate proposals for catching a bus.

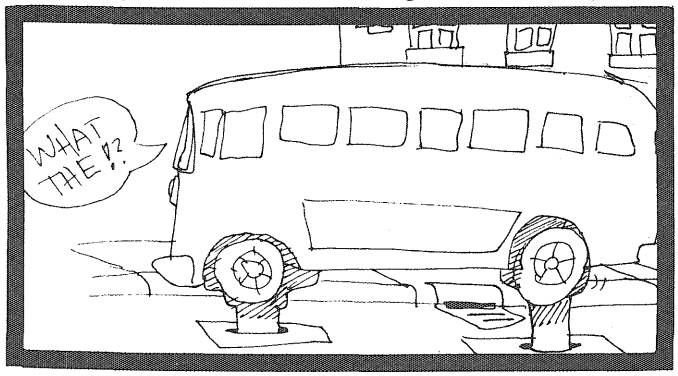
PROPOSAL #1 THE HYDRAULIC TRAP DOOR

The trap door should be constructed in the road bed of a bridge, because buses traditionally slow down while crossing bridges. When activated, the trap door is sprung, the bus falls through the opening in the road and is captured in the net hung under the bridge. A rope ladder is then lowered to safely transport the passengers out of the net. During this process, a roadblock is also sprung on the roadbed so that none of the vehicles following the bus do not also become trapped.



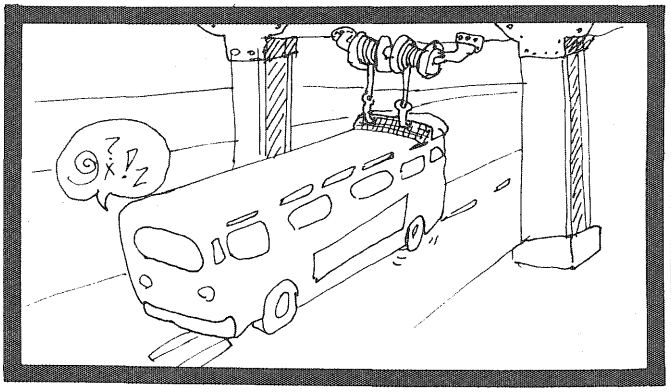
PROPOSAL #2--THE HYDRAULIC LIFTS

This method consists of two blocks, embedded in the road surface. Hydraulic lifts are constructed in these blocks, which would be operated by radio control. When a bus approaches the lift area, a signal is given and, when timed correctly, the lifts catch the bus just behind the front wheels and just in front of the rear wheels. Thus, the bus can be safely lifted while also being rendered helpless.



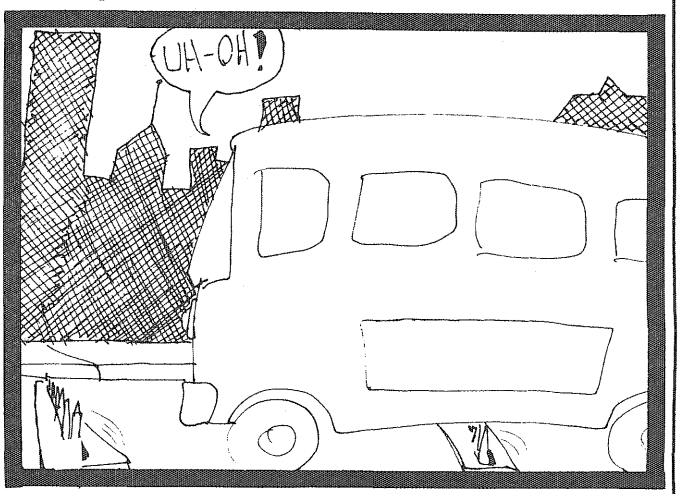
PROPOSAL #3--THE HOOK

Designed especially for the discriminating bus catcher who wishes to only ride in the newer, air-conditioned buses, the hooks would hang from a bridge or any convenient overpass. When lowered, the hooks would be designed to snare the air conditioning unit which is located on the roof of the newer buses. Once snagged, the hooks would raise up and dangle the bus helplessly in the air.



PROPOSAL #4--THE SPIKES

Designed for the more sadistic bus catchers, the spikes consist of a series of two sets of long nails, shielded by a protective covering, on a road surface. When the fated bus approaches, the spikes are activated, causing the protective covering to slide off and expose the spikes. Then the spikes rise up to puncture the bus tires, causing immediate blowouts in all four wheels.



The **Technolog** is always happy to respond to written requests for particular articles. Usually, those queries come from our readers. In this case, we are not sure of what they are. To call them readers is certainly giving them the benefit of the doubt. They probably only look at the pictures.

Anyway, the **Technolog** will not respond to threats or intimidation. But just to be on the safe side, we are including a 16 page, full color section devoted exclusively to "Hot Rocks." It begins on page 37--we hope you will be pleased.

Aprul 32, 1975

TACKylog

Deer ~~Tichnolog~~ :

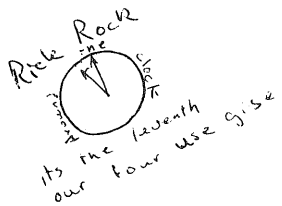
Wee tink youse guys is two egeneaRing oRienTed - why donut yu smarte up! Cus wey Whant too sea SUM joosey stooRies about Rockes !! That is write dumboes, youse iz nouw up agansT the geologie ande geoPhiziks KRew! Git wyze fast bea-4 youse cum Too WURK won DAy ande fynd youRe ophises Sucked intwo a byg subducktion ZONe ande Remeltud intoo 9 fourusters Pole !!!! Remumber, KNow WON foools wit an Earth Raper !!!!!!!!

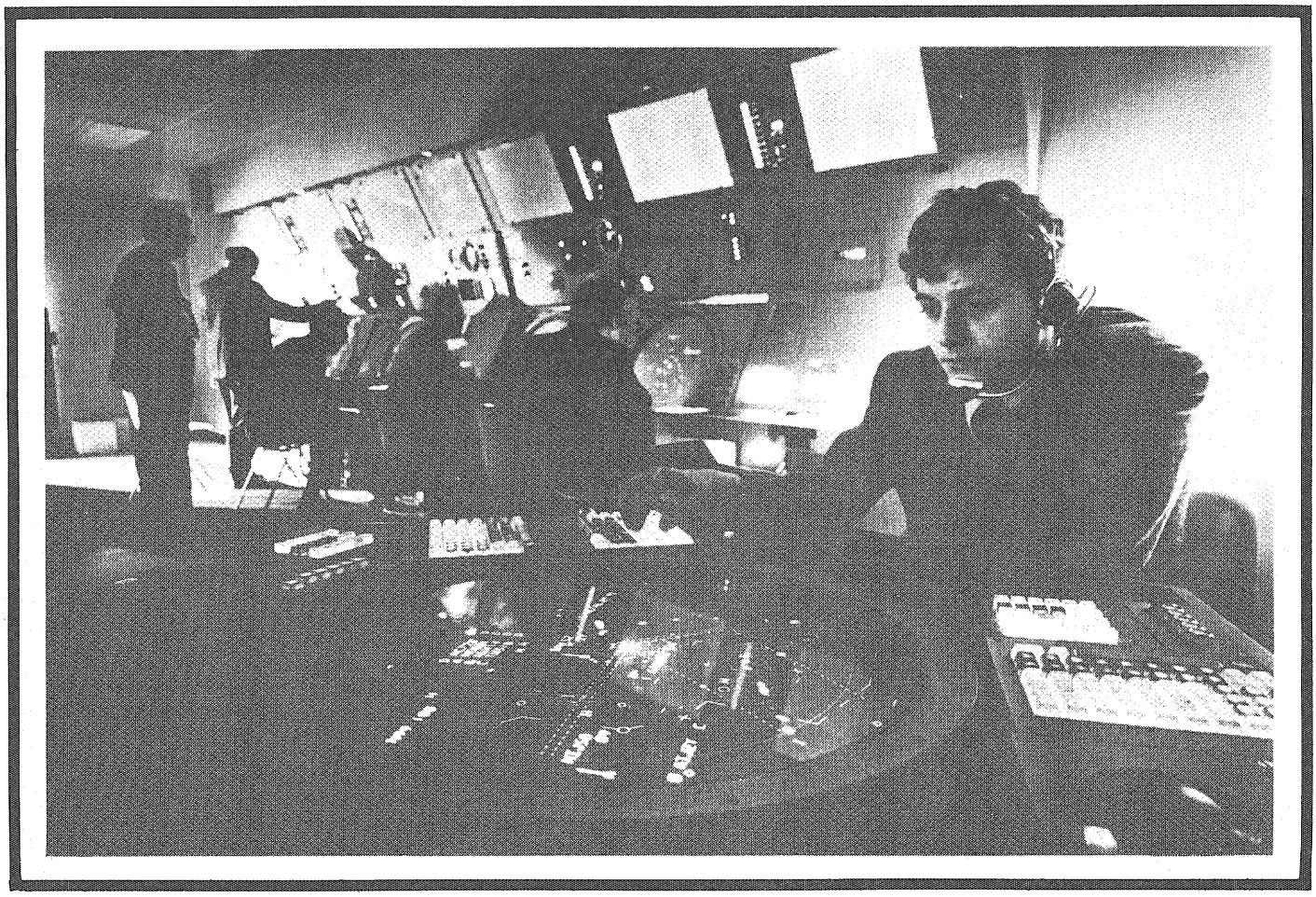
(QUACK, QUACK)

AL Geology
EmpeRoR = Geologye Klub

Foxy - Rockey
VICE EmpuRoR = Geologie clob

Joe "SOCK ITCH" Cool
ATHLETICK DiRecTUR = Geologie Klobb





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Univac people are its most significant asset.

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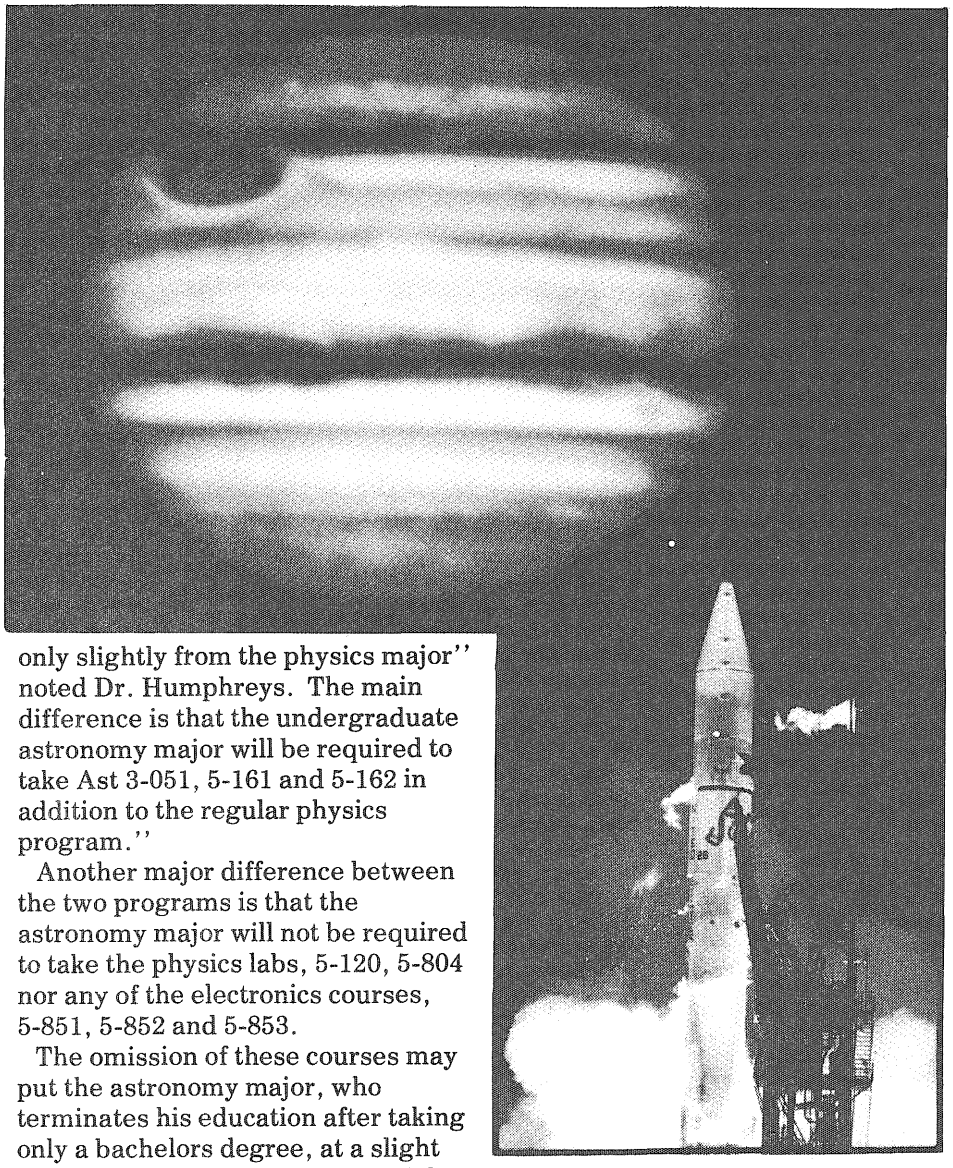
SPERRY UNIVAC

undergraduate ASTRO-PHYSICS

by Richard Morey



Astronomy majors--your star is now approaching it's zenith Next year, a new degree program will be available at the University, offered through the Institute of Technology. That program is an undergraduate degree in astronomy which is officially titled as "The Undergraduate Astrophysics Major--B.S. in Astrophysics.

What is the main reason for the initiation of this program? Mainly the degree is "the result of student pressure." said Dr. Roberta Humphreys of the astronomy department. "It's most psychological; the freshman astronomy major comes to the University and gets a physics degree. The astronomy majors do not like being lumped in with the physics majors. They want to be separate, to be able to write down the word "Astronomy" in the little space when filling out class cards. Now the astronomy major will be able to do that. That is the main reason for the new program."

While elitism may be the major reason for the new program, Dr. Humphreys pointed out that there are other goals intended for this major. "The major is designed for the person who is planning on continuing into graduate school" she said. The undergraduate astronomy major will be given a preview of what to expect in post-graduate study and will be provided with a more specific background with which to handle it. A person concluding their education at the bachelor level will be at about the same level of competance as an individual who graduates with a bachelor of physics. Of course there will be differences between the physics and astronomy majors, but the overall differences in required coursework, between the physics and astronomy major, will not be a radical one.

"The astronomy major will differ only slightly from the physics major" noted Dr. Humphreys. The main difference is that the undergraduate astronomy major will be required to take Ast 3-051, 5-161 and 5-162 in addition to the regular physics program."

Another major difference between the two programs is that the astronomy major will not be required to take the physics labs, 5-120, 5-804 nor any of the electronics courses, 5-851, 5-852 and 5-853.

The omission of these courses may put the astronomy major, who terminates his education after taking only a bachelors degree, at a slight disadvantage in seeking industrial employment as some employers prefer a practical aspect to the applicant's education. A practical aspect is represented, at least in theory, by these lab and electronics courses.

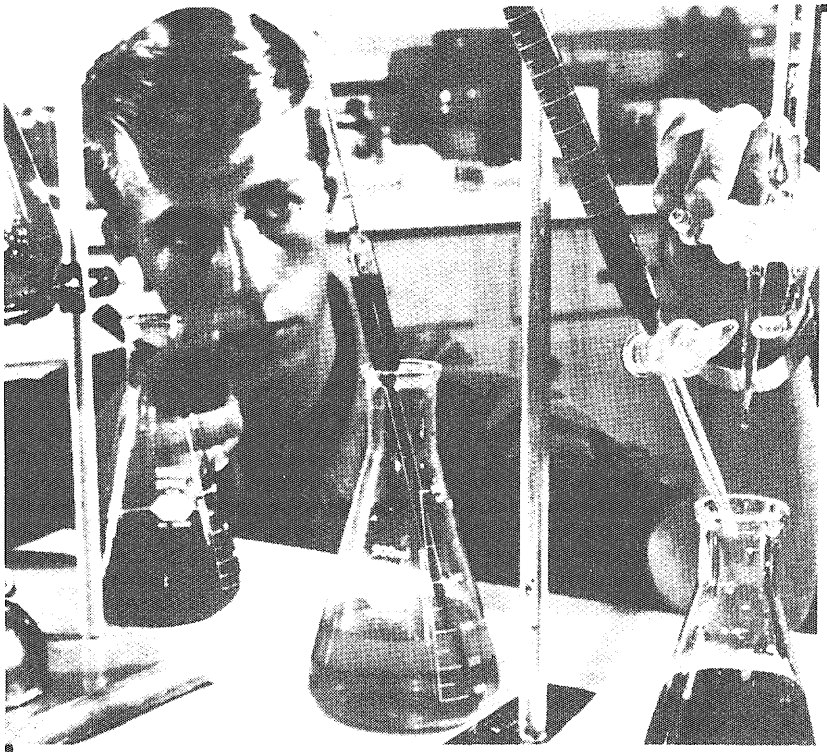
Other differences between the astronomy and physics programs are of a minor nature.

All in all, the significance of the new major is hard to predict. Looking to the near future, what it means is that there will be a few less physics majors next year and a few new majors in astronomy. □

The Astrophysics major will be essentially the same as the physics major except that Ast 3-051, 5-161 and 5-162 will be required. A total of 197 credit are required for the degree, including both English comp. and a language.

REQUIREMENTS:

LIBERAL EDUCATION--36 credits
MATHEMATICS--1-211, 1-221, 1-231 (first year calculus), 3-211, 3-221, 3-231 (diff. eq., linear algebra), and electives (statistics and/or programming. These three areas should total between 37-39 credits.
ASTRONOMY* ASTROPHYSICS AND PHYSICS: Ast 3-051, 5-161, 5-162, Physics 1-271, 1-281, 1-291, 1-275, 1-285, 1-295 (lab). Physics 3-011, 3-012, 3-015 (lab). Physics 3-511, 3-512, 3-513, 5-021, 5-022, 5-023, 5-024. This totals to 64 credits.
RECOMMENDED COURSES Ast 1-021, 1-022 (lab), 1-201. Physics 5-101, 5-102. Physics 5-201, 5-202. Physics 5-804. This totals to 29 credits.
SUGGESTED ELECTIVES include Geology, Chemistry, Meterology Physics 5-441, 5-422, Cloud Physics 5-451, 5-452, 5-453, Cosmic Ray and Space Physics 5-441, 5-442, History of Physics 5-923, 5-924, 5-925, and Electronics Lab. Elective credits should total to between 12-14 credits. Add the English comp and language requirements to get to the required 197 total credits needed for the Undergraduate Astrophysics Major.



1. Do you have two years of college remaining?
2. Will your degree be in engineering, science or math?
3. Would you like to be part of a dynamic aerospace organization?

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WAGING A PRIVATE WAR ON UNEMPLOYMENT

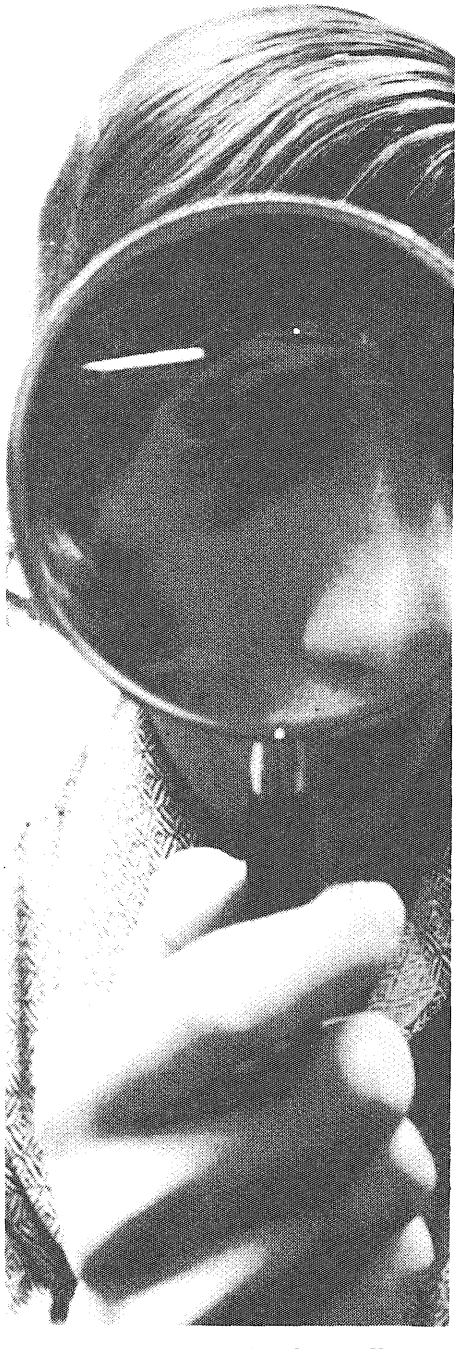
by Jack Rink

Coming home from school after a tough quarter, your father greets you with a cheery "Got a job lined up yet?". For your birthday your family gives you a suitcase and a placesetting of dinnerware. Your mother tells you to be sure and visit home often. When you politely remind her you still live at home, she shakes her head and mutters, "I know, I know."

These may be some of the first subtle hints that it might just be time to sever the old family ties and start thinking about getting a job. But these days finding a job may not be quite as simple as it sounds. Keeping in mind that the economy is sputtering, a college graduate cannot expect to be showered with glamerous employment offers from hopeful employers. So actually the first real job a college graduate may have is in sales--selling himself to an employer.

In general, the job market is rather bleak. But an engineer who is planning (or praying) to graduate soon has at least two factors working to his advantage. First of all, the chances of finding a job in engineering are still good. Probably the worst possibility that a fledging engineer may face will be having to relocate or perhaps not receiving his first choice of job assignment.

Secondly, through the I.T. Placement Service, a graduating engineer has the opportunity of contacting over 200 separate companies. A chance to interview with so many companies so easily will never happen to you again.



The I.T. Placement Service is located in the subterranean catacombs of the Experimental Engineering Building. (Experimental Engineering is the crumbling brick hulk just east of Main Engineering. It was recently voted the "Least Likely to Remain Standing Award.") This year the Service worked with between 350 to 400 students, which is roughly one half of the graduating engineering class. The reason why so many students use the Service is simple--it works. Of the Fall 1974 class, the last one on which fairly complete figures are available, at least 70 percent of the graduates are known to have been placed. This figure is deceptively low however, since many graduates do not report back with the Service once they find a job.

The Placement Service is really a modern day matchmaking operation. Companies that are interested in hiring engineers are invited to send a recruiter to campus. The Placement Service then encourages interested students to sign up for interviews with the recruiter. The advantage of this system is that a student can get a serious job interview with a company that is genuinely interested in hiring, without all the hassle of making endless applications before finding a company with an opening.

From the time of the interview onward, matters are strictly between the company and the student. However, if a student encounters unusual difficulties, extra assistance is available. For example, if a person finds they cannot talk easily with a recruiter, the Placement Service can supply counseling and advice to help the student present himself more effectively at the next interview.

The best way to completely understand I.T. Placement is to trace the system through a typical cycle. The placement process begins the first week of fall quarter. Interested students attend an afternoon meeting where the entire system is explained. Students are also given resume forms to fill out and some tips on how to prepare for an interview. In addition, a recruiter is usually there to offer some further advice and answer questions.

The resume plays a very important role in the placement process. The information on it (grades, work experiences and so on) will comprise the first impression that a recruiter gets of a student. Leroy Ponto, Director of I.T. Placement, points out that consequently it is very worthwhile to spend the time to write a concise and accurate resume that still reflects some personality. "Put yourself in the recruiter's place," Ponto suggests. "If you are looking through a hundred resumes, you would be looking for the ones that show something different". If a student gives his permission, his resume will also be put in a file which is used by small companies interested in hiring only one or two

new employees, or by companies doing screening in advance of their interviewing dates.

Beginning the second week of the fall quarter, recruiters periodically visit the campus. Students interested in talking with the company representative must sign up in advance for an interview appointment. Any student graduating in the upcoming year is eligable and there is no limit on how many companies a student may interview with. The extremes in numbers of interviews per student range from one to over 30, but most students interview with an average of 12 companies. How long a recruiter stays on campus is pretty much dictated by the student interest and most companies try to visit the campus twice a year.

The interview itself is a mutual sizing-up session. For his part, the recruiter is trying to discover what kind of person the student is; something that no simple resume can show. Specifically, to evaluate a potential employee the recruiter will ask himself questions like these:

1) Personality--does the student have the ability to meet and deal with people?
2) Interests and Goals--has the student thought about his future?
3) Communication Skills--can the student express himself as well as listen and understand?
4) Appearances--is the applicant neat or sloppy? (This does not necessarily mean short hair and a suit)
5) Interest in the Company--has the student investigated the company on his own?

The recruiter will attempt to glean this information about the student by asking some pointed and at times difficult questions. The types of questions that a student can expect are general, open ended ones such as: "Tell me about yourself. What do you really like or dislike? What would you like to do in our company?.". With a little thought, a clever student (which admittedly may be a contradiction in terms) can use those questions to his advantage. Recruiters are looking for positive and enthusiastic answers. As Lee Ponto says, "A student who presents himself well can go a long way in determining his future."

Again, Ponto emphasizes that a little time spent in advance for preparation can make a tremendous difference in an interview. He notes that picking a job is one of the most important decisions in any person's life. A little incredulously, he observes, "A lot of students will spend less time preparing for the job selection process than for a class."

Recruiters have told Ponto that the image a student presents during an interview may have as much or even more impact than a student's grades. Companies are more interested in people with a combination of intelligence and personality than with sheer brilliance. Perhaps the best way to put everything in the proper perspective is to remember that a half hour interview may carry the same weight as the four grueling years spent suffering through school.

But all this does not mean that an interview should be a one-sided interrogation. The recruiter has the responsibility of selling his company and the student should not hesitate to ask any questions he may have.

Strangely enough, the questions that seem most obvious, those of pay and benefits, may not really be the most important. According to Lee Ponto, the pay and benefits for a beginning engineer are fairly standard. He feels that other, less material factors, should be considered first. Ponto suggests checking out things like:

1)--potential in the company,
2) opportunities for advancement,
3)--educational programs,
4)--job security,
5)--the amount of traveling the job involves.

About three weeks to one month after the interview, the student will receive some word from the company. The reply may be a polite raspberry or, if the recruiter has recommended it, the student will receive an invitation to visit one of the company's plants. The host company generally underwrites the expenses of a plant visit and uses it as another opportunity to size up the applicant. Once again, the company is closely watching how well the prospective employee can meet and

FOR MORE INFORMATION ON CAREERS

Occupational Libraries--Most departments have specialized libraries where career information is available.

Corporate Guides--Available at most public libraries, corporate guides list all companies operating in the state.

Introductory Courses--Classes listed as 1-001 Orientation in the various I.T. divisions often discuss job opportunities.

Seminars--I.T. Placement and other campus services periodically sponsor lectures and talks on resume writing, conducting interviews and other aspects of job hunting.

I.T. Placement--The first meeting for interested students is held early fall quarter. This year, an introductory talk may be held in the spring. Watch for announcements.

Career Development--A proposal for a two credit Career Development class is presently under study. Information will be released as it becomes available.

DIAL--The Digital Information Access Line has several tapes that may be helpful.

2604 Sources of part time jobs
2605 How to write a resume
2606 How to write a cover letter
1701 Making career decisions
1706 I.T. Placement Office

Student Employment Service--Part time job listings and counseling is available to presently enrolled students.

deal with people--people he may soon be working with. The student, in turn, gets a chance to see exactly what type of work he is getting into.

After the plant visit there is usually another three to four week waiting period. By that time the final step of the process is taken; the applicant is either offered a job or is once again "thanks but no thanks'ed". At the plant visit stage the odds of being offered a job are about 50 percent. In the past few years, 30 to 40 percent of the people who were offered jobs accepted them. This year, probably as a result of the economic crunch, roughly 70 percent accepted their offers.

Fnding a job through the I.T. Placement Service is probably the easiest and most effective way to become a genuine member of the working class. However, using the Placement Service is not the only way to find a job. In fact, Lee Ponto encourages students to use many methods simultaneously. He urges students to check the want ads, technical journals and ask other people who may know of leads. In addition, there is nothing to lose by using a private employment agency when their fee is paid by the employer. Industry uses many approaches to search for the best employees and it is possible to find a job through any one of them. "It is rare for a company to put all it's eggs in one basket," Ponto sums up, "and it should be just as rare for a student."

Under certain circumstances a student may not be able to use any placement service. For example, a person interested in a highly specialized area of a particular field, or someone wanting to work for a certain company must find or make their own opportunities. The only way to accomplish this is through the time honored system of submitting job applications and resumes.

As usual, there are ways to increase the odds of being offered a job. If possible, visit a company instead of merely sending a resume.

(Remember how important a job interview is in relation to a resume.) If the company is too far away for a visit, spend some time writing an introductory letter. According to Ponto of the Placement Service, it is acceptable to send out printed resumes, but never allow the cover letter to appear as if it is mass produced. A company will pay no more attention to a mass produced cover letter than a home owner will to a "Dear Occupant" envelope.

Fairwarning! Be prepared to do a lot of legwork in approaching companies in this manner. Sending out resumes (otherwise known as the "broadcast method") may well be the least effective way to look for a job, and the response rate is correspondingly low. However, if getting a certain job is vitally important, this method may be the only way of snaring it.

Leroy Ponto has a few final tips. Treat the job hunting process seriously and use initiative. Explore any and all avenues that might prove productive. Put some time and effort into the resumes and interviews. "The person who does the most research will find the best job--the one that suits him or her the most," says Ponto.

Be prepared to make a few sacrifices. Remember that the economy is more or less floundering. Getting that first job may mean having to relocate or maybe not starting in the exact position you desired. (The Placement Service reports few openings for Executive Vice-Presidents at the moment.) Most people seem to agree it is important to get started and acquire some experience. Then, when a better job offer comes along, grab it. Since statistics show that a college graduate's first job lasts only an average of three years, this is a relatively common pattern.

Finally, do not become discouraged after reading this article. After all, this article is crammed with terms like work, jobs, acting personable and being reasonable. Most college students have spent four or more years avoiding those very things.

Besides, having a job means 8 to 5, wearing suits and ties, suburbia, paying taxes and so on.

Still, there is always grad school....

Still, there is always grad school...

BEELZEBUB'S TRAPEZOID

The Explanation of all Those Strange Disappearances Around the Campus

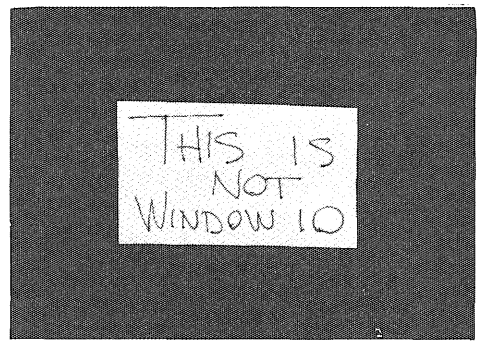
by Bill Loye

Recently, a strange phenomenon has been reported in the Twin Cities area. It is not unlike the so-called "Devil's Triangle" (not the fraternity) which has received so much publicity. However, while scientists, explorers and radio superscars travel to the famous area off Bermuda, they overlook an equally bewildering site located right here on our own beloved campus. Scientifically labeled "Beelzbub's Trapezoid", the more common term by which it is known is The Immorill Whorl. The Whorl (see the map) is shaped with a northern boundary through the southeastern corner of Northoup Memorial Hangar and the southwestern corner in the Architecture Box. The southern boundary is located along the north faces of Swelter Library and the Syphics Building. The east and west boundaries are along the respective sides of Immorill Hall.

Countless unexplainable occurances were not on file in the offices of the **Minnesota Doily**, a local paper put out to encourage cub scouts for paper sales. Since the **Doily** has never been interested in publishing facts, they have no reason to keep records or files. But as I looked through the non-existant files, I found some astounding items.

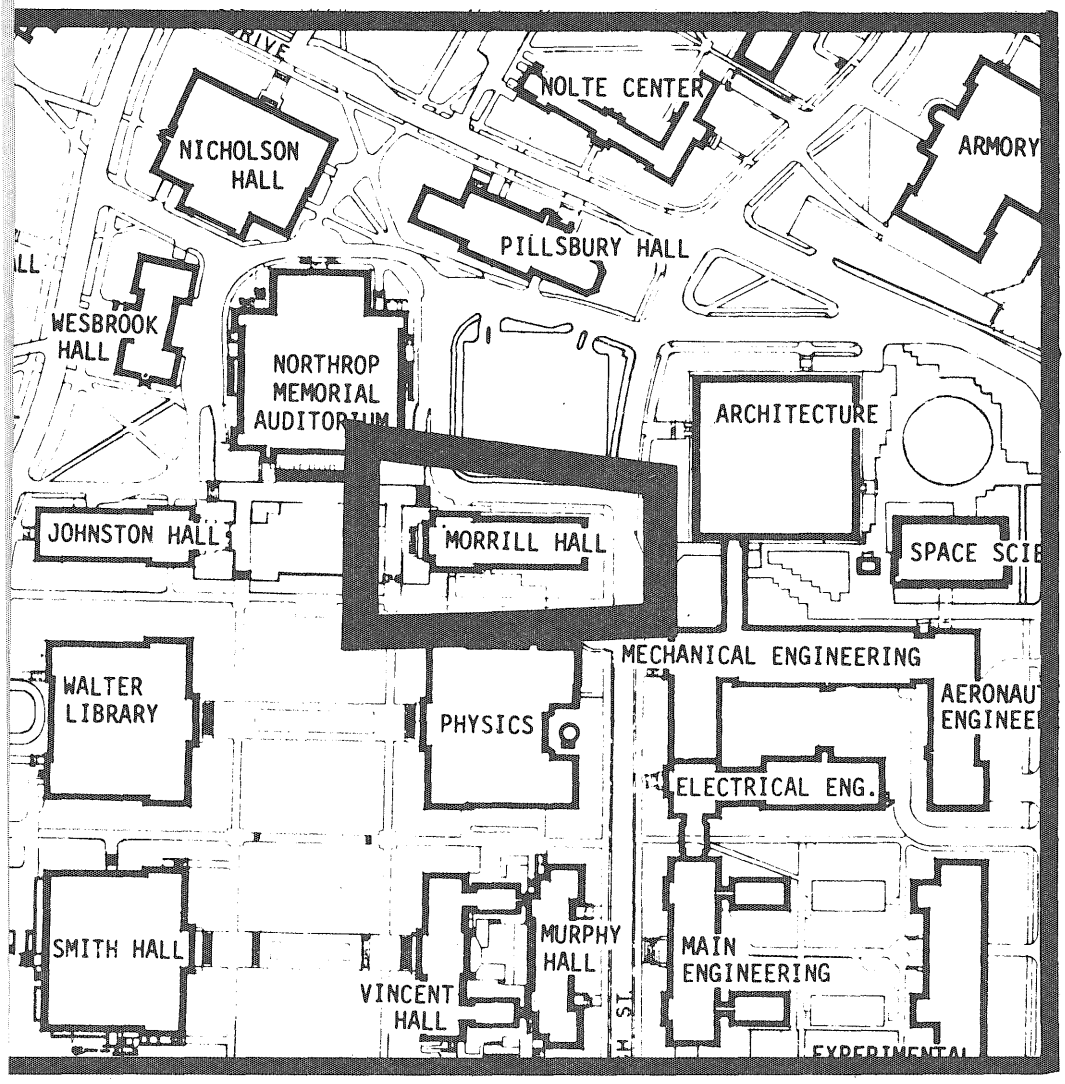
Take the enigma of Window 10. Deep in the catacombs of Immorrill Hall there exists a window that has been so often mistaken for the actual, ill-fated Window 10 that it must exhibit a sign stating that it is not the aforementioned window. Is this a hoax or might there have once been an actual Window 10? If there once was a Window 10, where did it go? What was it's use? Was it a friendly window? The answers to these questions may never be known. This reporter was able to talk to no one who could ever remember being at a Window 10 in Immorrill Hall. So if there is an answer to this enigma, it is shrouded in the deep confines of the Immorrill Whorl.

Another mysterious disappearance, this one involving thousands of humans, occured in January of 1968. The lone survivor was a freshman Journalism student, Bobby Orrip. Here is Orrip's written account of the incident; "I had just walked into Immorrill Hall. It was about 10 in the morning. I looked into the bartering area and there was no one there. No one at all. There were no lines, no cursing students, not even at Window 30. The secretarys were there. Although they had a dazed, dumbfounded look on their faces, nothing else seemed normal. Then I thought of the thousands of frustrated students that are always locked in combat and conflict within that area and I wondered where they all went to. Suddenly, the drinking fountain exploded and a rush of white water came shooting through. Dimly, through the cloud of water, I saw what I thought was a window, with a sign above it which read "Window 10." When I saw that I did a quick pirouette and stumbled out of there. The next thing I knew, I was on the steps of Northoup Memorial Auditorium, clutching a pocket Bible and a full color picture of Jesus, which a friendly religious zealot had given to me for a mere $10.00." The University police officially closed the case, saying that



the students must have gotten disoriented during the drinking fountain flood and were washed away. As for Orrip, he has never recovered from the shock. He is now spending the rest of his days at the "Happy Log Sanitarium", playing hearts with the other inmates and listening to Kris Kristofferson records. But the questions remain. Can Orrip's testimony be trusted? Did those students really get washed away in that "flood" or were they sucked into the Immorrill Whorl?

Then there is the case of the Geology 1 class that never returned. It was a clear, sunny day with no



meterological disturbances on which to blame the disappearance of that ill-fated group. It began soon after they left Hillsbury Hall on their trip into destiny. Even as the stout group chased right along on their way, the hook had already slown them down. Their rapping had ceased. Then suddenly, they disappeared --during broad daylight, less than one block from the safety of Hillsbury Hall. Geology student Chick Stealthing was to have gone on that trip, but had declined at the last moment because of an odd feeling in his left eye. Says Chick, "I talked with my good friend Mark Cavitition, who also had a strange feeling in his left eye. As I think back on this, I know that it was an omen. And Mark's last words were truly prophetic. He said to me "who the hell wants to go on this crummy trip anyway?". And now, he's gone."

Gone--still more victims sacrificed to the Immorrill Whorl.

The strangest case not on record that I found is still baffling the police. Although they claim the victim is alive and existing in California, we must express doubt about that view. It is the case of Dr. Malcolm Mooch, an administrator of high standing whose unexplained disappearance is destined to become another chapter in the saga of the terrible trapezoid.

It was a cloudy, windy day as Mooch left his office. His secretary said, "Malcie was so upset that day, he said that if he did not return, I should see Peter 'Quick-Draw' McGraw. And then, standing high, he left". Those words were the last words heard from Mooch. His date with destiny had arrived--and he was never heard from again. McGraw, in an interview after the incident said "I think it was the poor weather, not some supernatural power, that was responsible for this disappearance. Mooch was always going out and standing high and I think he finally just got blown away."

But could this actually happen? Could a high standing administrator get blown away or, rather, was he swallowed up by the mystery of the Immorrill Whorl?

In a search of the secrets of this monstrous area, we interviewed the world famous astronomer and story teller, Dr. Farlis Kaufmanitosnicus. When he was asked to express his views on the Trapeziod, Kaufmonitonicus was quoted as saying "beats me." One of his colleagues, Dr. Ampscurrent commented on Kaufmanitonicus's statement by saying "I must categorically and unquestionably agree with the theory expresssed by my learned friend."

Editor's Note

This is the first draft of a manuscript submitted by **Technolog** investigative reporter Bill Loye. Unfortunately, Bill never got to finish his assignment. It seems that Bill Loye has added his name to the list of victims claimed by the dreaded **Beelzebub's Trapezoid**, or **Immorrill Whorl**. It seems that Bill, along with staff photographer Rick Rhapht, while investigating the Immorrill Whorl during the week of April 28th, suddenly and mysteriously disappeared. Investigations by the police and private investigators have turned up no rational explanation for their disappearance.

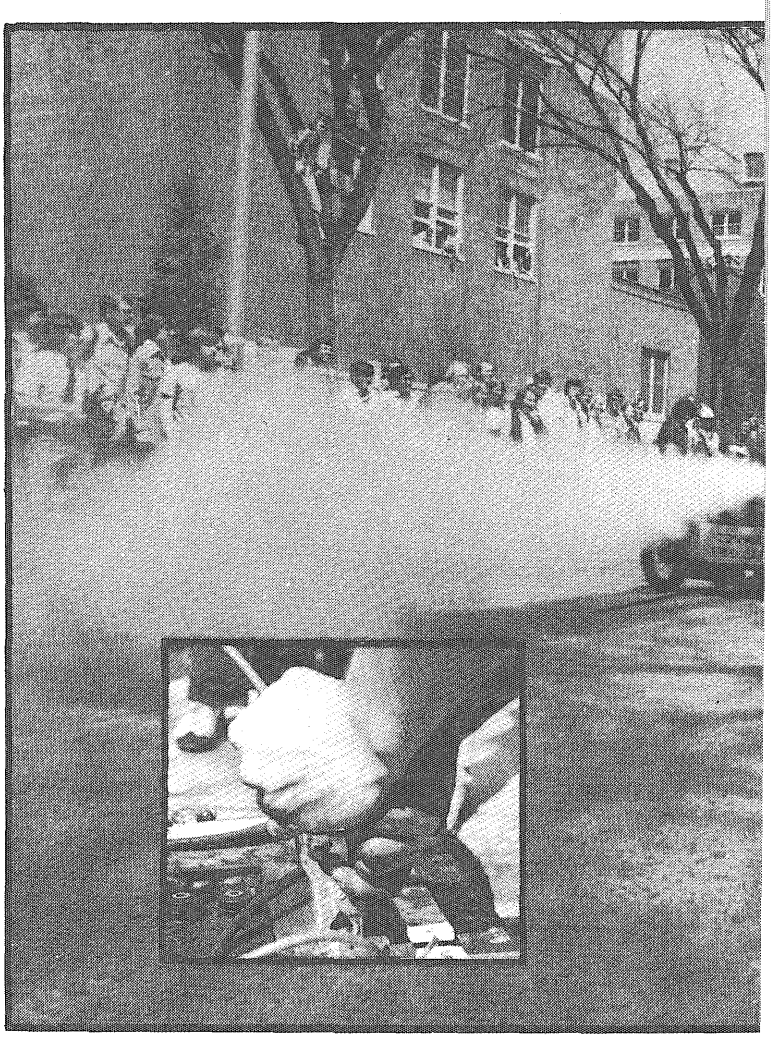
1974.

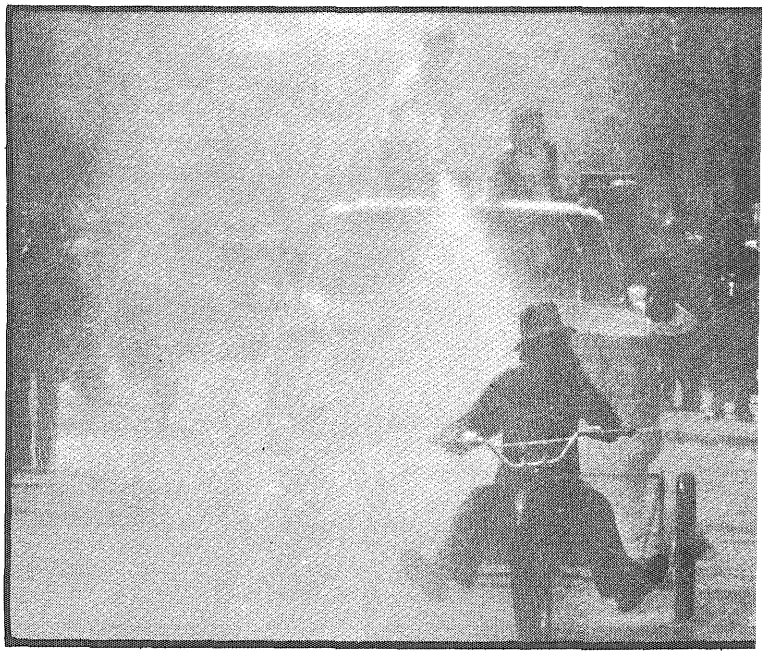
today.

Bill Loye

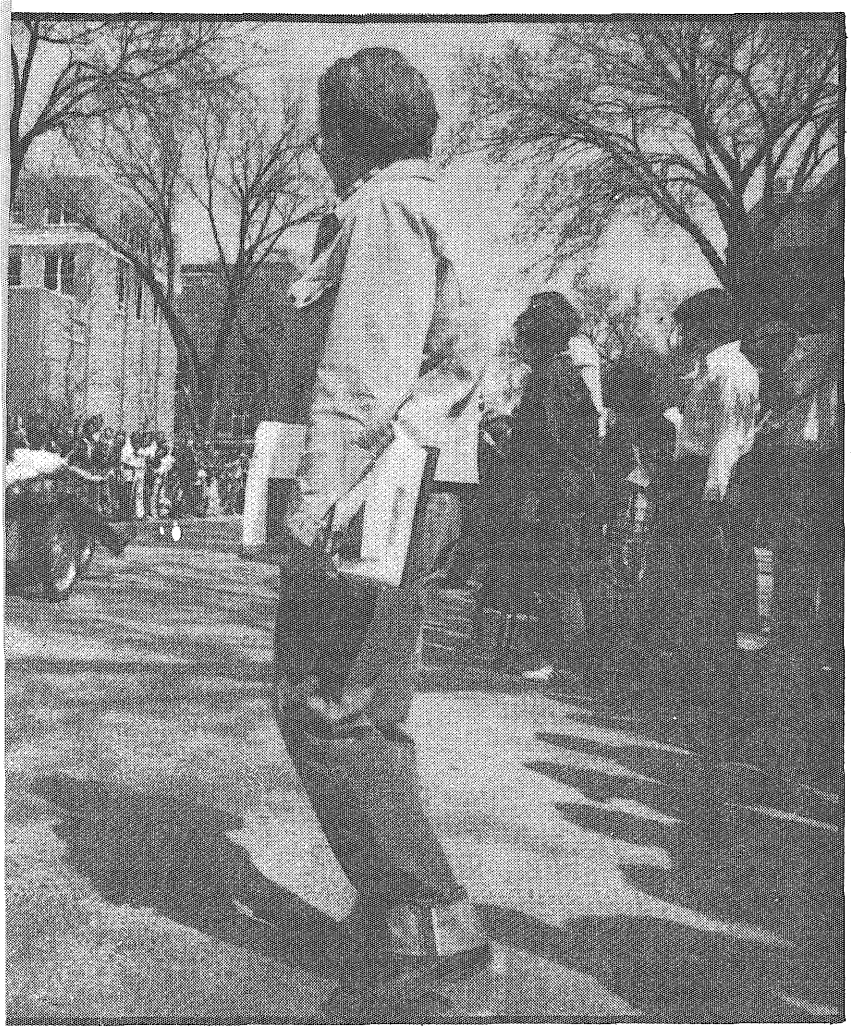
So the **Technolog** would like to express it's thanks to Bill Loye, a "machine gun" wit, and a crackerjock journalist. "Rocky", as he was often called, will be missed. In his honor, the **Technolog** is renaming it's card table "the Bill Loye Memorial Slab".

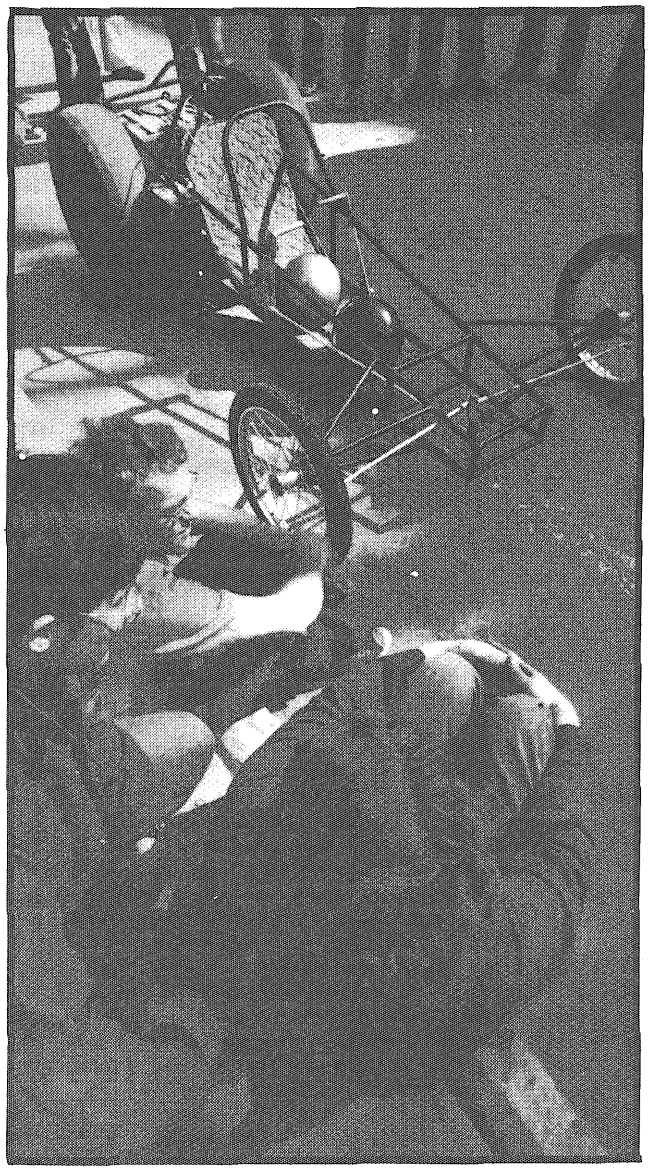
E-DAY

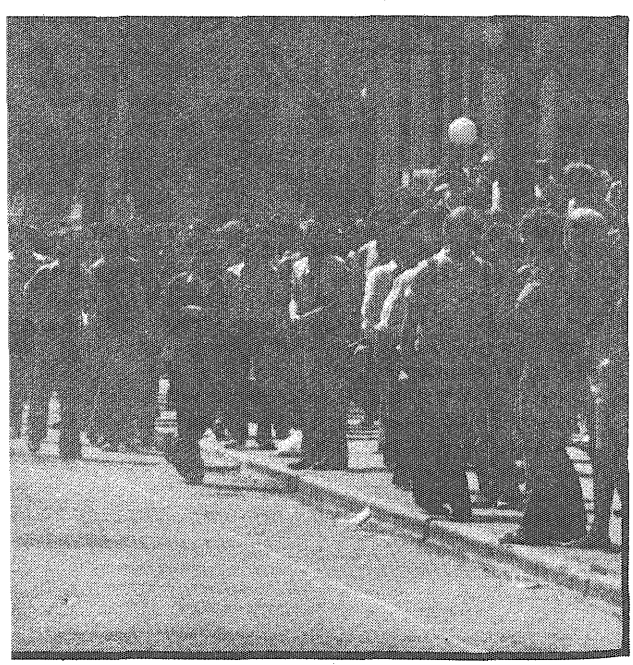


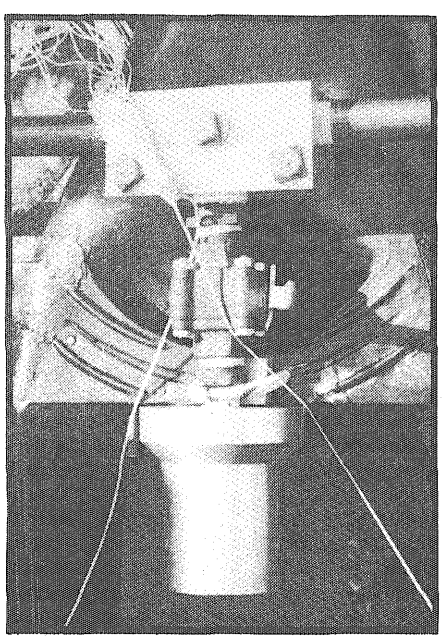


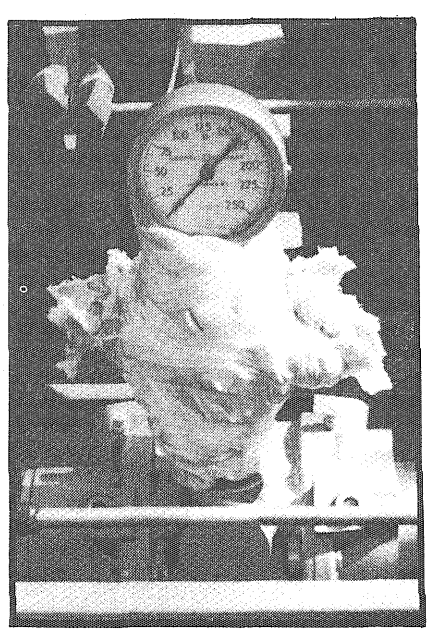
75 CAR RACE

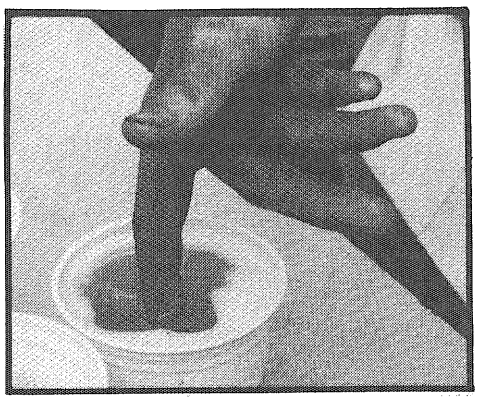












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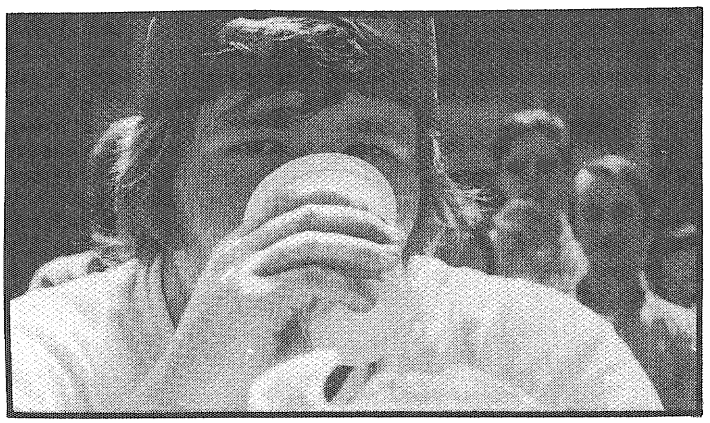
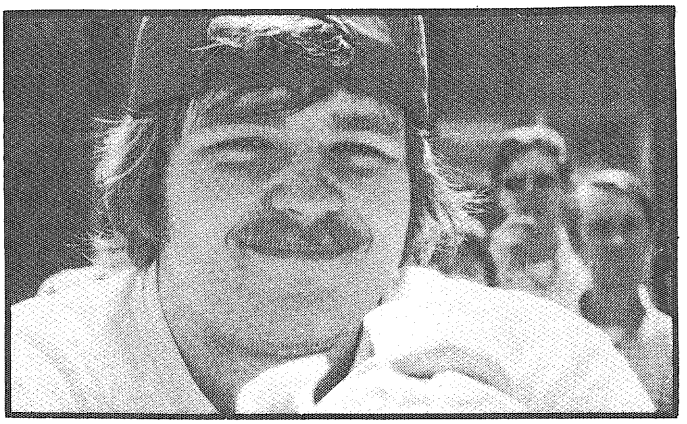
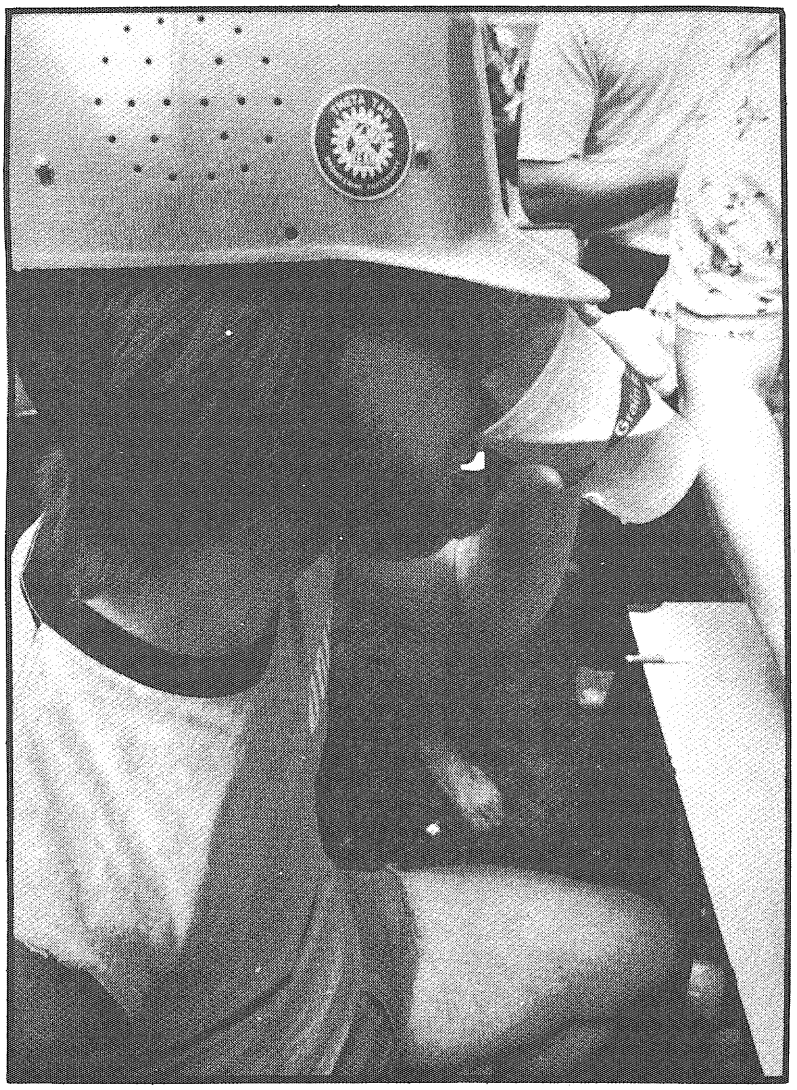
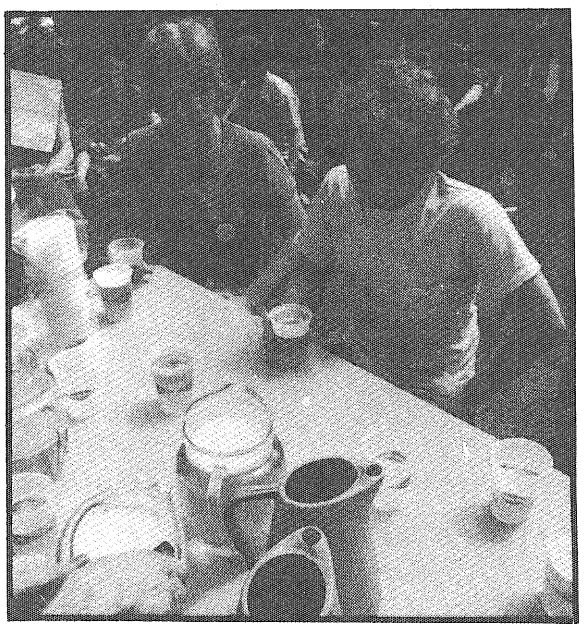
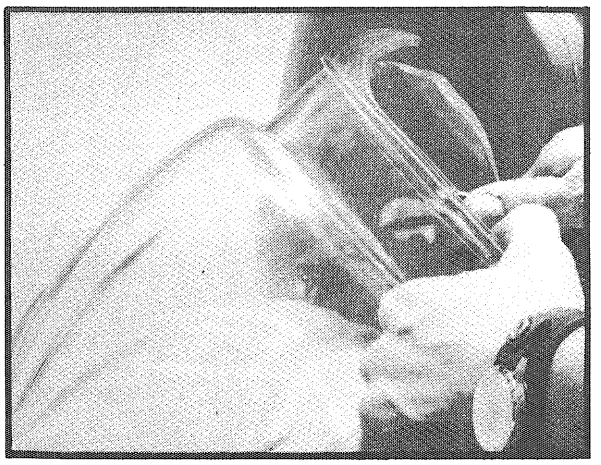
BEER DRINKING











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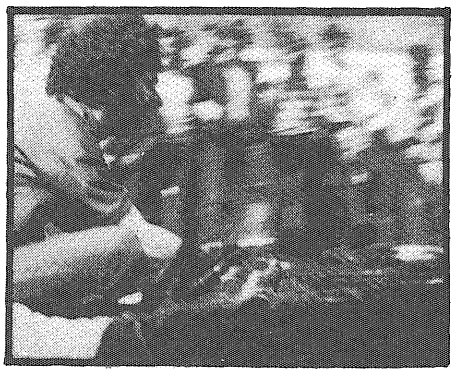

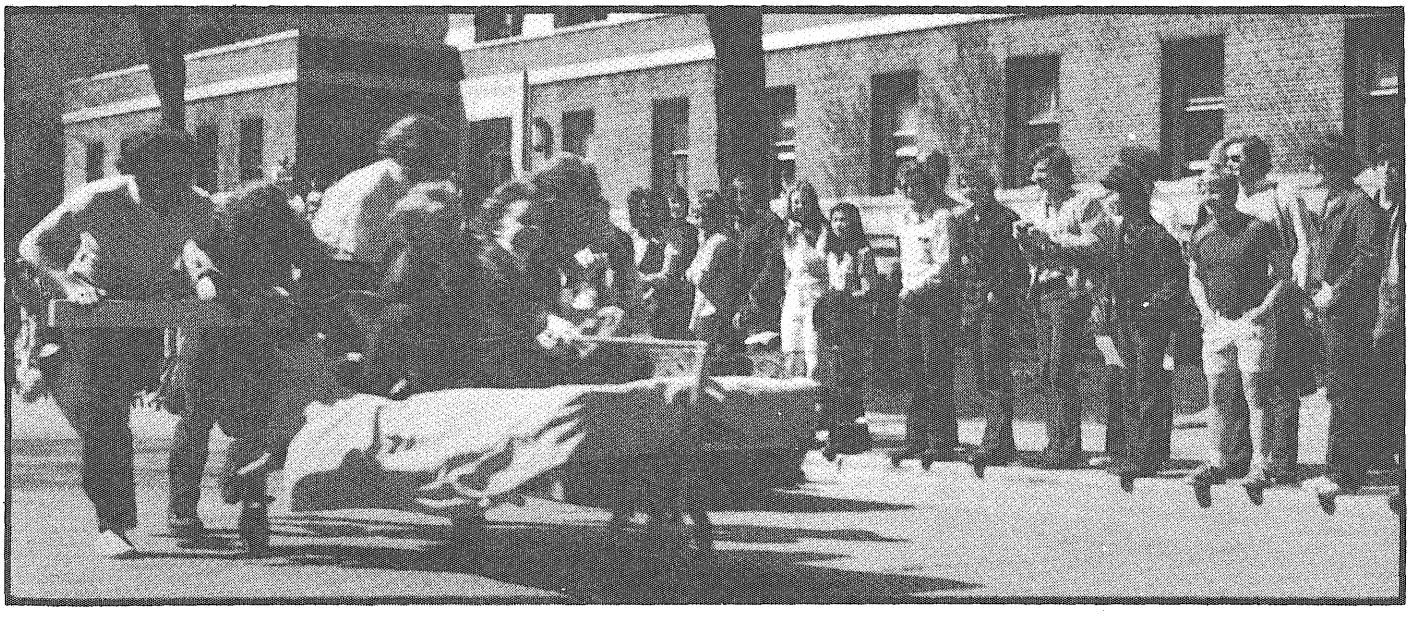

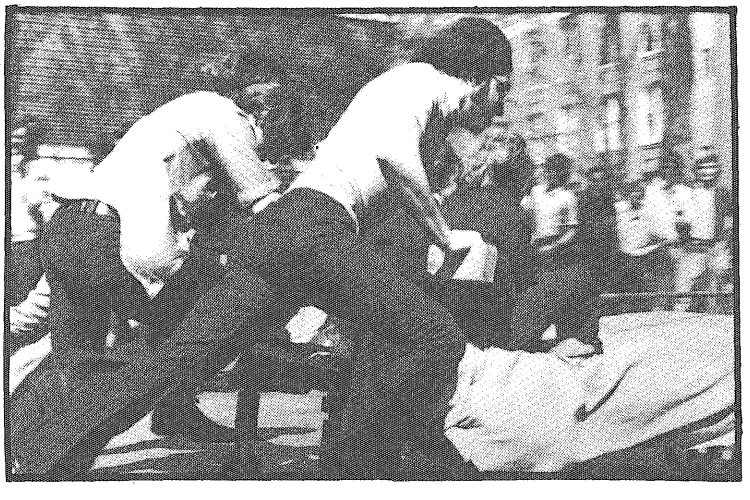

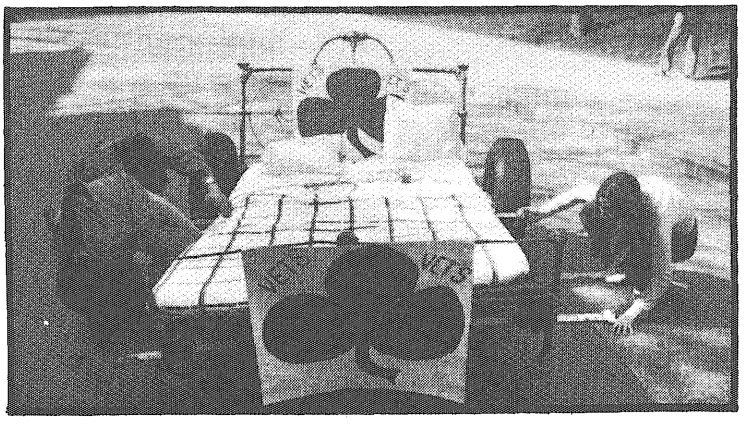

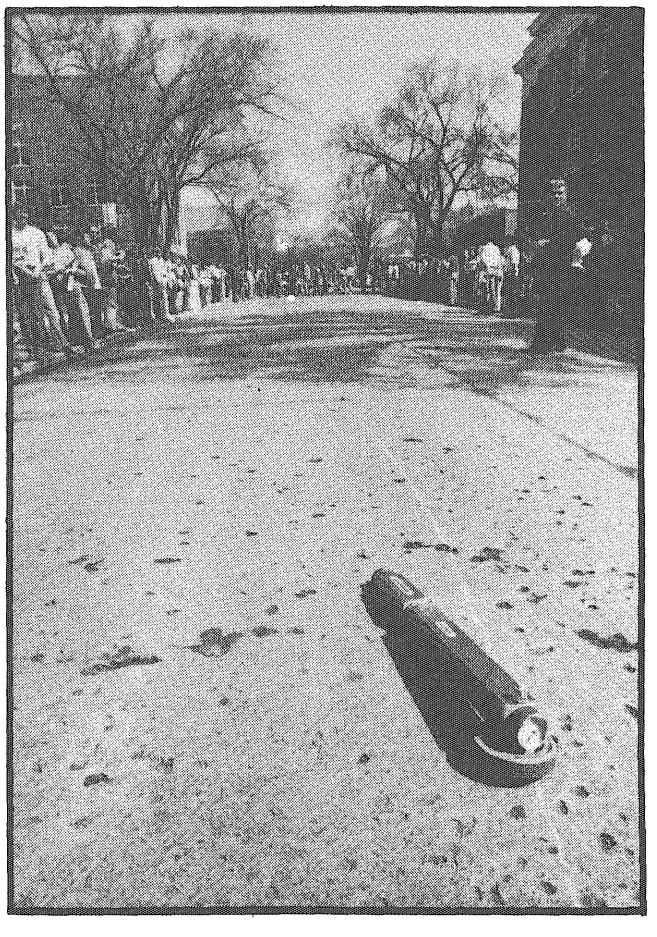

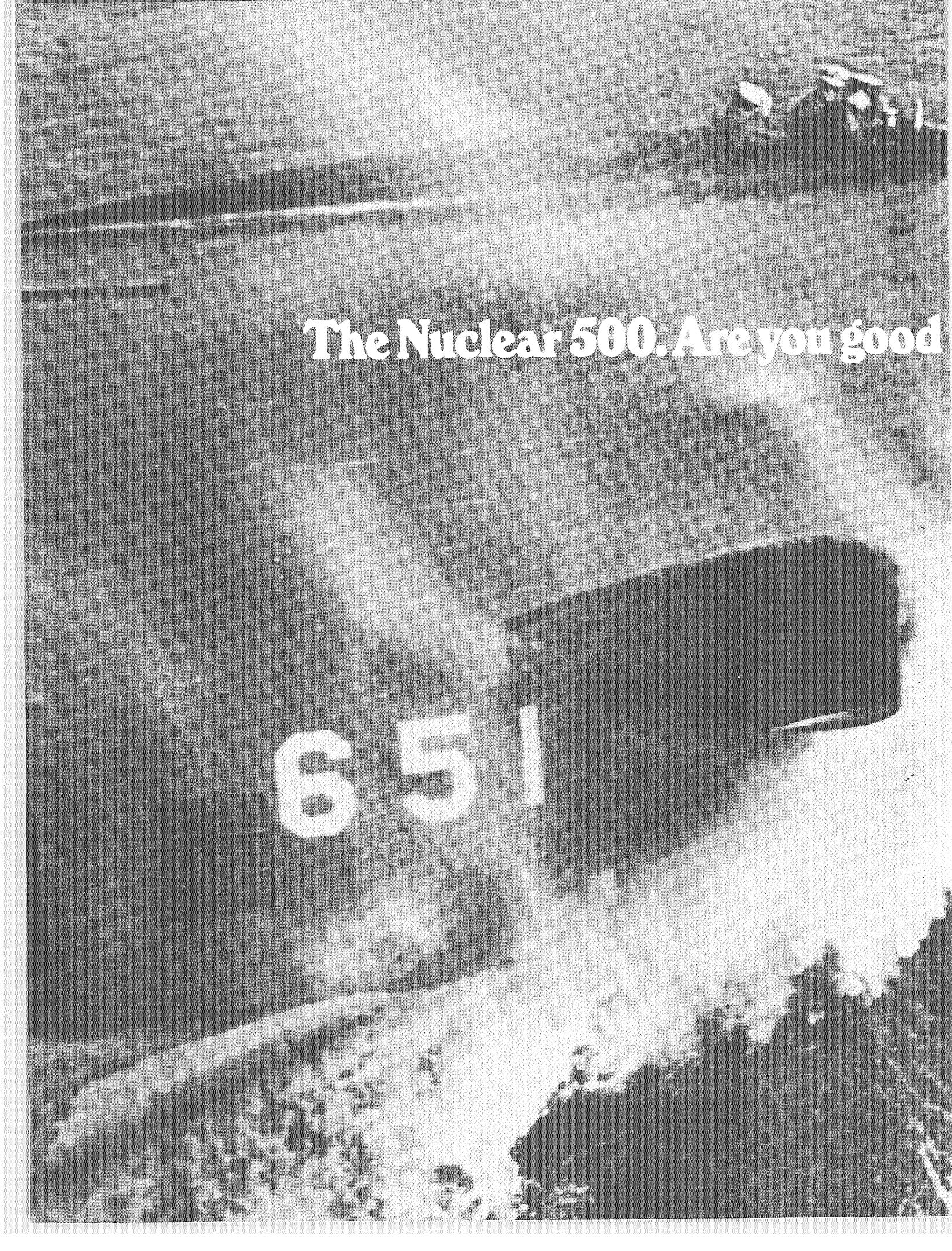
The Nuclear 500. Are you good
651

enough to be one of them?

This year the Navy will seek about 500 of the country's top college graduates for its nuclear energy program. It's the most comprehensive training program available in today's most exciting energy field.

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There is a chronic shortage of women who are active in the Institute of Technology. This shortage is not peculiar to the University. Rather, it is a nationwide trend of long endurance.

National figures for 1974 show that women comprise only 4 percent of all students enrolled in engineering colleges. Certain engineering fields have an even lower percentage of female enrollment. For example, on a national scale, Civil Engineering contains only three percent women and only two percent of the potential Mechanical and Electrical engineers are women.

Locally, the picture for women is getting brighter and brighter. Over the last few years the Institute of Technology at the University has developed a relatively powerful recruitment program, aimed specifically at involving women in I.T.. The Institute of Technology is trying to replace the image of I.T. women as "stared at while on the job but overlooked when the time comes for salary increases and promotions." The main selling points used are the explanations of the open, well-paid job opportunities for intelligent young women. This recruitment program has certainly helped to attain an overall female I.T. enrollment which is more than double the national average. A total of 9.4 percent of all I.T. students at the University are women. The 1974-75 academic year found the efforts of recruitment proving to be successful once more. The number of freshman women in I.T. more than doubled, from 40 in the fall of 1973, to 83 in the fall of 1974. The freshman I.T. women comprise 11.7 percent of their class.

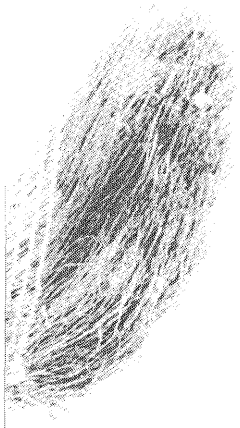
However, the Institute of Technology has run into special problems in trying to obtain a more equal number of faculty women. Presently, in a faculty of nearly 400 members, there are only 8 women. I.T. is making a special effort to eliminate these problems, but the key seems to be the relatively small numbers of women I.T. graduates. The Dean of I.T. Richard Swalin, said in 1970 "one of the principle reasons there are so few women professors is that the total enrollment of women in these (I.T.) fields is extremely small." His comments are still valid today. Although society's attitude towards sexual roles have changed somewhat in the past decade, the number of women entering I.T. fields, around the country, has not changed significantly. The national enrollment figures, quoted earlier, seem to point out that although national opinion has changed to the point where women are accepted in nearly all occupations, many women still do not enter the traditionally male-dominated engineering fields.

"Women just do not view Institute of Technology fields as appropriate," said Associate Dean Walter Johnson. He felt that this was definitely one of the special problems I.T. administrators have been faced with.

One of the greatest of the obstacles faced by I.T., as well as the entire University until 1969, was the Nepotism Rule. This rule prohibited persons who already had a family member working in a University position from being hired for the same position. For example, Dr. Phyllis Frier, now a Physics professor, was not advanced beyond a research assistanceship because of this rule for 18 years, even though she had a doctorate degree. This may initially look like blatant sex discrimination but in her case, her husband, Dr. George Frier, was already a Physics professor at the University. Nancy Pirsig, chairperson of the Council on University Woman's Progress (CUWP) called the now-defunct Nepotism Rule an "unnecessary impediment" for women who already had enough problems obtaining good jobs. "Women had to be kept out of jobs because of their husbands, and it seemed if one person was going to get a faculty position it would always be the man" said Ms. Pirsig.

Along with Dr. Frier, another of the 8 women who are currently I.T. faculty members, is Dr. Roberta Humphreys, in Astronomy.

I.T. WOMEN:



they're here!!

by Roxann Goertz

Dr. Humphreys describes herself as "very sympathetic to the women's liberation movement." While she sees great improvement in the attitude of the Institute of Technology towards women, she still senses barriers remaining in some traditionally male I.T. fields. "Once everyone gets used to women in these fields it will be natural, but right now, they continually tell you that you do not belong there" Dr. Humphreys said. "This is due to society which tells women their role lies in the home," she said. "Some people tend to think discrimination of this sort is the natural law."

Dr. Humphreys went on to point out that in her opinion the female who enters into traditionally male-dominated areas are more dedicated students. While science always takes personal dedication, she feels that a woman must work harder because she has more hurdles to overcome. One of those hurdles is the reaction of her male peers. Drawing from several experiences, Dr. Humphreys remarked "what they (your male peers) really wanted was for you to play the typical female role--never questioning or competing with them."

Is Dr. Humphreys forced to play that role? She says that in her professional life she is "an astronomist first, then a woman."

In the 1950's Dr. Phyllis Frier feels there was a similar time of "less emphasis on the home. I think that more girls went into male-oriented occupations then," she said.

She felt that the situation of sexual discrimination has greatly improved since those times. "It's much easier for a girl to consider becoming an engineer now than it was 10 years ago," she said, as an example of the improvement.

As a woman, Dr. Frier sees further handicaps. She feels that students often consider a woman professor to be more leniant and understanding, so they tend to take advantage of her because they are less afraid of her. "Students may act a bit more babyish" in asking favors of her, she stated. Dr. Frier also noted that "I've received extra department work and other odd jobs that they feel only a woman in the department could do.

Although Dr. Frier is sympathetic with the woman's liberation movement, she feels that things are good now since "women have an option." They are able to make a choice about what their role in life will be and this, to Dr. Frier, is the important thing a woman should insist upon.

Hopefully, by producing more and more women graduates in engineering, more faculty positions will eventually by filled by women. On the undergraduate level, the Institute of Technology is stressing the present open job market for I.T. women as a positive recruitment point in their program.

"There is quite an emphasis on trying to hire I.T. women--particularly in engineering" said Leroy Ponto , Director of the I.T. Placement Service. "We do get a few companies who ask us for a list of our female graduates" he noted, "but of course we never supply them with this kind of information." Ponto strongly believes that for the most part jobs are not being offered to I.T. women solely because of their sex. "If we were to see manifestations of tokenism, then there would be many more job offers made just to women" Ponto remarked. "Instead," Ponto said, "a company is still primarily interested in what a prospective employee can do for them, whether that employee be male or female." But the main implication is clear--a woman engineer, for perhaps the first time in history, has an advantage in seeking employment. This obvious recruiting advantage should help to increase the number of women enrolling in the Institute of Technology for the next few years. Dr. Johnson points out that the University "is competing with all other universities and industry" in attracting women to engineering but, as Lee Ponto believes, "a competent female engineer should not have any problem getting a job." □

TWIN CITIES RADIO

Special Section Written By Robert Pirro Designed By Kevin Strandberg

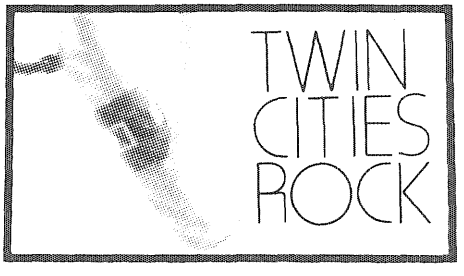
Practically everyone has wanted to be on radio at one time or another. Being a "DJ" is a common day-dream but very few of us actually know anything about the industry.

The Twin Cities is probably the most competitive rock radio market in the country with four AM rockers; WDGY, KDWB, KSTP and WYOO-U100. With other stations such as KFMX-FM, KQRS, WLOL and WCCO-FM which play, at least some, rock music, the radio dial here is crowded with contemporary music offerings. The reason that the Twin Cities has so many rock stations is simple--there can be big money in presenting rock music.

Every privately owned radio station, whether or not it is a rock station, exists solely to make money for it's ownership. Once realizing this fact of economic life, it becomes easy to understand why selling commercial time--which is the only method a conventional radio station can use to make money-- is so important. To sell advertising time, you must present proof of listener-ship to your clients. This all leads to the vital importance of ratings (see sidebar for a more complete ratings summary). Much like the Neilsen television ratings, radio ratings provide the basis for all decisions in the radio industry. The choice of format, music, announcers and everything else is dictated solely by how many listeners you can attract. The ratings provide the only industry -wide accepted method of measuring that subjective factor.

There is big money behind Twin Cities rock radio, as each of the AM rockers are owned by large corporations. KDWB is a subsidiary of Doubleday, the book publishers. U100 is an offspring of Fairchild Industries who are an incredibly diverse conglomerate. KSTP is merged with KSTP-TV and the other ventures of Hubbard Broadcasting. WDGY is in the Storz Broadcasting chain, a nationwide string of radio stations. WDGY broke the ground with it's rock format in 1957, as chronicled by Rob Sherwood; "WDGY goes back to the days when the late Tod Storz was virtually one of the inventors of Top 40 radio. Tod Storz was the son of Robert Storz, the current man in charge. Tod was given radio as a plaything, virtually, by his father who owned a beer brewery, and Tod created something that was worth more money than his father ever had."

KDWB hit on a "Formula 63"



presentation and began rocking around 1959. For over 10 years, these two stations battled back and forth with WDGY usually emerging as the top rocker. This situation was healthy for both stations as was observed by KDWB's True Don Bleau; "both stations (KDWB & WDGY) did well enough, both did not have to worry and both were probably not of major market quality." This radio market became truly big league when 15-KSTP arrived and initiated some real competiton in 1972. The birth of U100 in August, 1974 tightened the competition even more.

With four AM rockers, the main difference between them is not the music but the format.

Format can be defined as the method of presentation of what is on the air. Format consists of playlists, contests, promotions and overall station policy and is set up to achieve the highest possible listener appeal. Rob Sherwood of U100 points out that "the most important thing for any successful radio station is that you have to relate to your market. Once you've decided whats here, then you narrow down who you are going to go at demographically, by age. Radio stations that spend a lot of time trying to please everybody end up, quite frequently, pleasing nobody!" Chuck Knapp of KSTP adds that "this is the age of specialization where you have to shoot for a certain demographic audience. We shoot for 18-34." Charlie Bush of KSTP agreed with Knapp, stating that "KDWB has got the bubble-gummers, and they can have them--18 to 34 is the name of this game." The age U100 shoots for is teens plus 18-24. KDWB is going for a 12-34 year old target with recent emphasis placed on the 18-24 year olds. WDGY is stressing the overall 12-34 market. Johnny Canton points out that to achieve maximum programming results, a system of different programming for different parts of the day, called day-parting, is employed. In the case of WDGY, Canton revealed that their music "is all pre-programmed in advance... and the music is all day-parted. We don't want to wind up playing "hello Dolly" by Louis Armstrong on The Cat Man's show at 8:00 at night or to play something real heavy on my show (9:00 a.m. to noon). That is all taken into account to maintain a nice, adequate balance." Day-parting can become complicated, because the average age of the listener changes during the day.

But regardless of day-parting, the most important element in any rock station's format is the music itself. Rob Sherwood notes that "you can replace any disc jockey but you can't replace the format."

"There is not a lot of difference in what is being played" says Chuck Knapp, "but there is a difference in timing, when you jump on a record." Knapp them whistfully revealed a

facetious fact of radio life; "I love to let U100 play everything, let them play every record that comes out. We'll sit back and we'll decipher which week is the right week and which record is the right record. It eliminates my guesswork--just to sit back and wait until the record becomes a medium record and then jump on it, make it a hit and get all the credit for it (chuckle)."

The music on KSTP consists roughly of 50 percent current and 50 percent old songs. The only real format they have is to shout out "15-KSTP" as soon as a record ends. They have other format rules, such as never play less than two records in a row, mention certain promos at certain times etc. KSTP publishes a Top 30 playlist but according to Knapp, he "does not play everything on it." KDWB also plays about 50 percent current and old records, although their program director, John Sebastian, hates to put labels on his music. In choosing music Sebastian says that "you've got to totally realize that your audience has got to program your station, really." Their playlist is anywhere between 25-35 records and their oldies vary a great deal in age and frequency of airplay. U100 plays about 20 percent oldies with a playlist of 25, at the most. WDGY uses a "Hot 20" to go along with about 1,000 oldies, dating back to 1964.

Now, how do you get a job playing these records? There are three basic ways, 1) you hang around a radio station and beg for a job, 2) you go to broadcasting school, such as Brown or Elkins, or 3) you go to college. "If I had to recommend a way" says Rob Sherwood, "I would recommend college, but all three are going to help you get that first job just as easily." Johnny Canton and Chuck Knapp got their first jobs in radio by hanging around a small station. Rob Sherwood went to Brown, John Sebastian did a little of both. That first job is the toughest, according to Sherwood. He said "it's the old thing where you'll get people saying you need experience, and the corresponding reverse of that will be 'how do I get the experience when no one will hire me?' The way to get that first job is be in the right place at the right time, be a little lucky, be willing to work a little beneath what you think you should be working."

There are an estimated 30,000 jobs in radio, although only a relative few are financially lucrative. The national average salary, according to Rob Sherwood, was estimated to be around $5,200 a year. This figure was brought down by the low pay in many southern and southwestern stations. Both Sherwood and Chuck Knapp estimated that the average salary of a rock disc jockey in the Twin Cities falls somewhere between $15,000 and $30,000.

Now, what is the criteria for getting here as a rock jock? "The only necessity is to sound good, to sound polished, to sound like it's coming easy to you" says John Sebastian. The only real way to get that polish is to get as much experience as possible. Although there are exceptions, nearly every jock in the Twin Cities put in dues at smaller markets.

The actual job itself is relatively easy to define--you do your show. Other than doing promos, reading commercials and making personal appearances, if you can perform their format, keep your nose clean and get adequate ratings you can stay. Job security is the only real minus in the industry. Very few disc jockeys work with a formal contract other than their union (AFTRA) contract. This agreement covers all the minor aspects of employment, but provides little in the way of job security. Another contract that is sometimes invoked is an exclusitivity agreement which binds the jock to a particular station in the area but only if that station wants him. The station can fire the jock anytime it wants to, but the jock cannot leave and join another station in that listening area. This sort of agreement was allegedly used to keep KSTP's "Smokin" Joe Hager from being hired by KDWB.

Few jocks use an agent and universally do their own job seeking. The method they use is to take an "air check" which is a tape of how you sound on the air and sent it to the station(s) they desire to work at. An air-check is, in effect, an audition and it is your foot in the door for any gig you want to work.

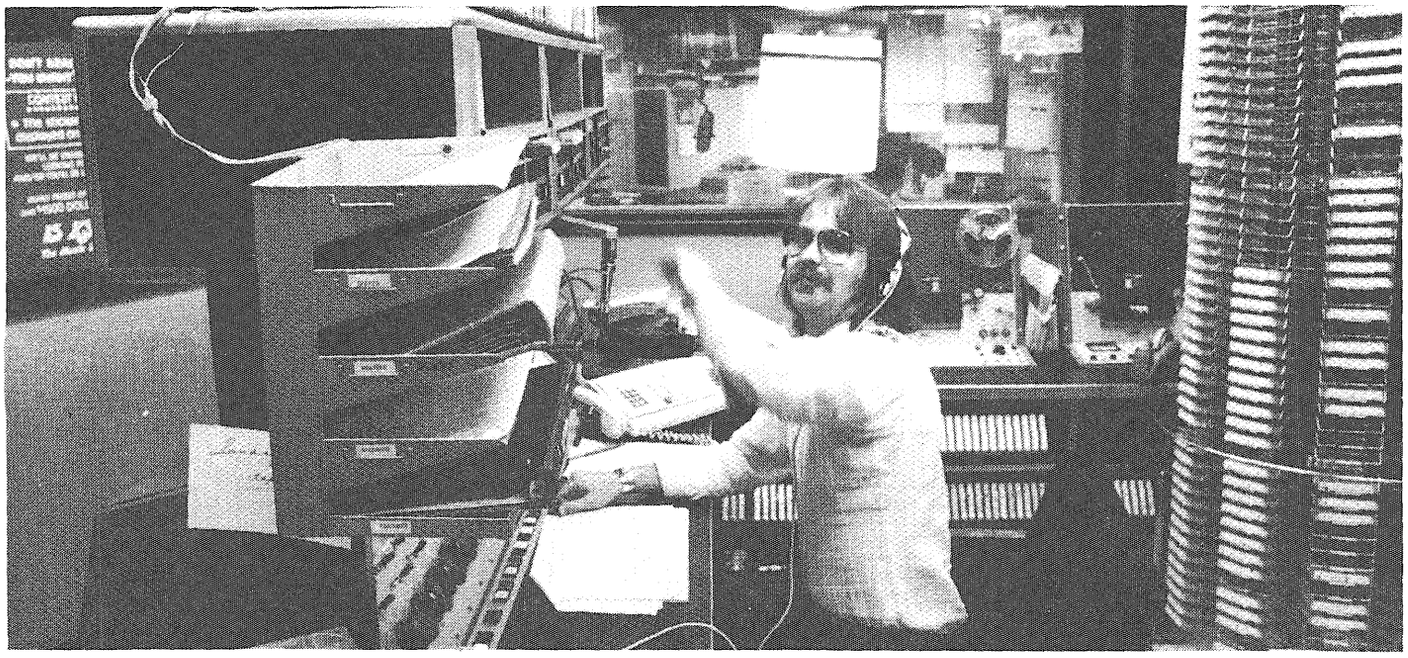
Aside from popular legend, there are really no major industry "traps" in radio that cannot exist in other jobs. The image of the partying jock with groupies hanging all over him and drugs flowing freely, is as true in radio as it can be in virtually any other field. It is probably more common in radio because of the notoriety, but it is not necessarily the norm. What is the norm, however, is the exciting and the unexpected, because this is a field which is alive. What radio is about was summed up by Chuck Knapp; "when I was working in Chicago the **Chicago Daily News** took a survey which showed that 85 percent of Americans were bored with their jobs. You're not gonna find that at this radio station and you probably won't find it at KDWB or WDGY or U100 either." Rob Sherwood's summary has to do with achieving success in radio; "in radio theres no such thing as a status quo. You can never stay even, you are either going up or down. You can keep a job by being adequate but as far as growing within that job, the only way to do that is to just hustle, to work 115 percent all the time."

THE RATINGS

To adequately explain ratings could take a book. Suffice it to say that ratings are the most complicated and most easily manipulated element in radio.

There are basically three ratings services. The Hooper survey is only used to measure market trends. Chuck Knapp, among others, holds Hoopers in small regard, saying "you might as well roll it (Hooper) up and smoke it. It does nothing." Pulse is a service in little use here. Tim Monahan, ad salesman at KSTP revealed that "Pulse is only an also-ran. It is only used to verify the ARB." The ARB stands for Arbitron, the most respected ratings service in America. It is a diary service, taken four times a year where listeners write down who they listened to at what times. The ARB is broken down into a myriad of terms, including metro and total surveys, ave. shares, cums, ave. persons, shares and others in every conceivable age group. While I honestly now understand this mess, I simply do not have the space to explain it to you. So, if anybody is interested enough to want to know, come on down to the **Technolog** and I'll be glad to lay it on you.

By the way, KSTP is #1, with U100 #2, KDWB #3 and WDGY #4, but that is if you take the metro average quarter-hour ave. persons share. If you take the total survey area total cums than WDGY beats U100 but not KDWB which....



TWIN CITIES ROCK

CHUCK KNAPP & CHARLIE BUSH

"Elton John. Isn't that a plumbing outfit in Wisconsin?"

That the sound of Knapp in the Morning. It is a popular sound, as it wakes up more people than any other rock station offering in the Twin Cities. Being rated number one is nothing new to Chuck Knapp. "I've been fortunate because all through my career it's been nothing but number one stations," he revealed. "That involves not only having some talent, but some luck, being in the right place at the right time, being hired by good people, having good people around to help me," he said.

Right now, one of the good people who are around to help Chuck Knapp is his "rhymin' time newsman" Charlie Bush. Knapp is lavish in his praise of Bush, a praise which borders on awe. "Charlie Bush? I can never say enough good things about him" Knapp bubbled. "He is the fastest cat I've ever worked with. He has the fastest mind...and is probably the most talented person I've ever worked with" Knapp stated.

For his part, Charlie Bush is indeed Charlie Bush. When asked about Chuck Knapp, Bush's reaction was "Chuck Knapp is a rotten, long-haired, left-leaning wierdo creep. But he is the nicest one I know." You actually have to meet Charlie Bush to appreciate how funny that remark really is. Charlie Bush is a large, happy man, secure in his own head and confident of his own ability. The Charlie Bush that we hear on the radio is the product of many years of experience in radio, culminating in his being a total professional. Originally from Eau Claire, Wisconsin, Bush has been a rock jock, middle-of-the-road announcer (MOR), newsman, program director and production manager at various radio stations until he came to KSTP 11 years ago. At KSTP he performed virtually every announcing function until he began the "rhymin' time" thing with Chuck Knapp three years ago. Even though they operate from different studios when on the air, these two work very well together, although it is difficult to envision Charlie Bush not working well with anybody.

When you talk to Charlie Bush, this blustery man overwhelms you with benevolent assaults. With twinkling eyes and a natural, ready smile, Bush will stand right next to you, sticking his face so close to yours that he couldbite off the end of your nose. He starts by firing off jokes, salvos and retorts to anything you say. Then he begins to turn the interview around and you find yourself answering questions fired at you by a real newsman. His spirit is infectous, and an instant friendship can be formed by just talking once with Charlie Bush.

Bush explains that when he does the news he "does not give you the funny news. We give you the funny side of the news that is there." A

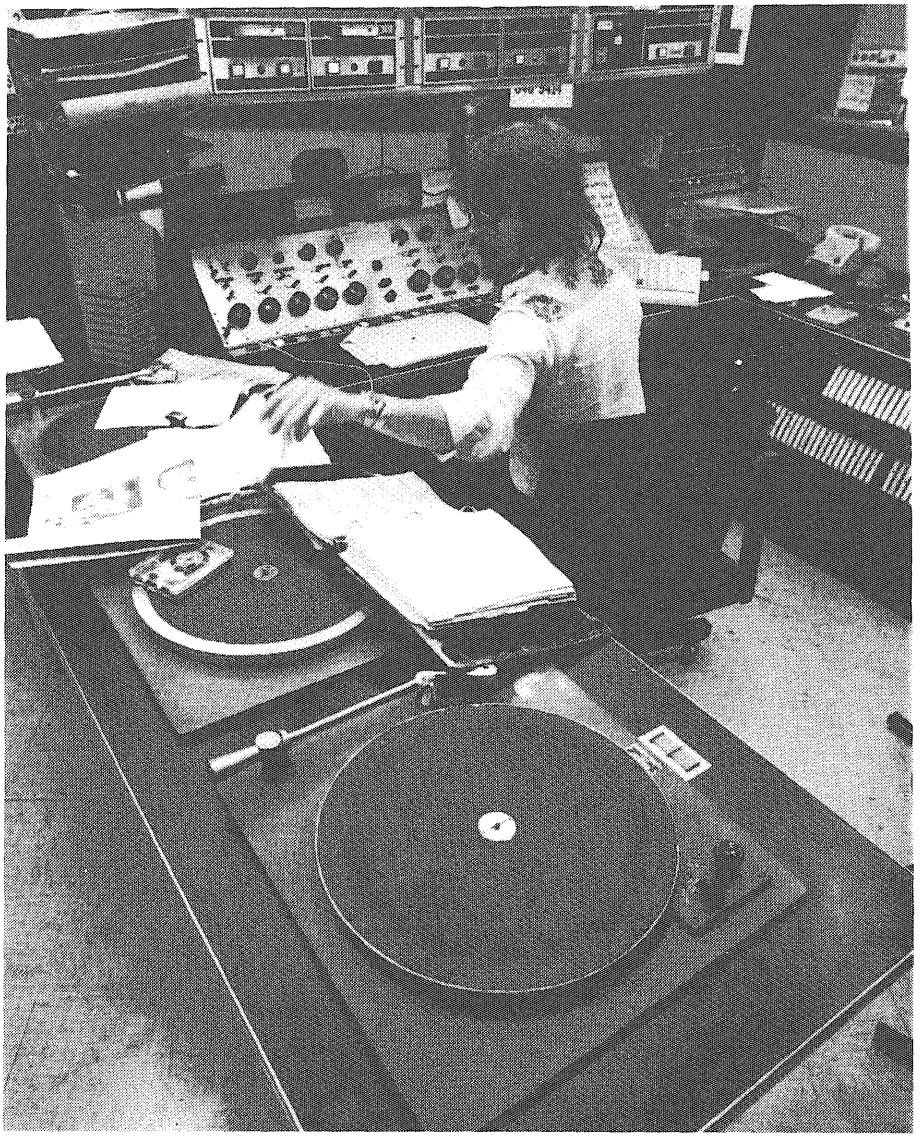
cynic, after listening to Bush some morning, might remark "you mean he actually does that for a living? I could do that!" However, the fact is that you or I really cannot do what Charlie Bush does because we do not have the experience or ability to pull it off. Apparently, nobody else in this area can pull it off either. The professional judgement of Charlie Bush, after watching him work, has to be that the man oozes talent from every pore.

Chuck Knapp is no slouch either, although he and Bush are about as different as can be imagined. Knapp's expertise is also based on experience; five major radio stations in four major markets before returning to his native state. Born 30 years ago in Fergus Falls, Chuck Knapp's radio education came strictly from experience. He took no college courses or technical school training to acquire his background. Knapp romantically reminisced about his early feelings towards radio: "I used to sit outside when I was 9 or 10 and listen to WLS in Chicago. I said that there would be a time when I would work there. And it did happen, about four years ago. Of course by that time I had already worked so many stations and done so many things that I knew pretty well what it was all about."

Knapp started his professional radio career in 1964. By the time he had worked stations in Fergus Falls, Fargo and Daytona Beach, Florida, he felt he was ready for the larger markets. In 1967 he applied for work at KDWB and was turned down because "they said that I was not ready yet." Yet in March of that same year, WRKO in Boston felt that Knapp was indeed ready and they hired him to do an early evening slot. From that gig, Knapp went to Chicago, via stop-offs in Atlanta and Cleveland. By the time he arrived in Minneapolis, Knapp had lived a great deal of life, "Christ, I've gone through two marriages, I've gone through any number of hassles on my way to being 30 years of age. I wouldn't go back a single year at this point in my life," he continued, "I'm getting to a point where I can really enjoy the business. I can really enjoy being on the air," he said.

In person, Chuck Knapp is basically what you might expect him to be like. He has long, full brown hair, wears wire-rimmed, tinted glasses, casual clothes and always seems to be physically mellow while his mouth keeps going non-stop. What comes out of that mouth is also Chuck Knapp. He sounds the same in person as he does on the radio. His inflections, emphasis and vocabulary are basically the same whether talking with him in his closet-like office or listening to him doing his show. Knapp agrees with this observation, saying "I sound like Chuck Knapp because when I'm being honest," he replied.

Talking with Chuck Knapp is a lot like holding a debate with a machine gun. The words come at the listener in droves. Yet what stands out in talking with this slender (not skinny) relaxed (his hands do absolutely **nothing** when he talks) man is the impression of honesty. Honesty is what Knapp is selling in this market and the notion of selling honesty is not as incongruous as it might seem.



on the air there's nothing else. The real me is on the air. The real me is in this office."

Now, who is 'the real me,' Chuck?

"The real me is a lot of different things. On the air I go through crazy periods and periods when I'm serious. I understand the ups and downs and I feel my audience does too. If I've got a cold, but I can go on, I go on and tell 'em 'I feel horseshit. I've got a cold.' And they can identify with that. It's called getting down with people, it's

All radio is an illusion--that is probably why it has been commercially successful for more than 50 years. Any listener can identify anything with any radio personality. Chuck Knapp and Charlie Bush give voice to many of those hidden feelings that you and I would like to get off our chests. Knapp and Bush are almost like your id expressing itself--like two latter-day Marx Brothers who thumb their noses and laugh at the common work-a-day world that we mortals must function within. But Knapp and Bush are

mortals too, and that is the honesty which comes across every morning during their show. Knapp and Bush are what you and I would like to be for awhile each morning, irreverent, interesting and seeming to thoroughly enjoy being themselves. That image is easy for any listener to relate to.

When asked about honesty in radio, Chuck stated that "I really believe that honesty is the bottom line with people. I don't believe that you should bullshit 'em. I just totally be myself on the air. We don't put on any pretenses. We don't claim to be anything except probably two of the better people in radio, doing what we're doing. We've worked hard to get there, so we feel like we can say that."

When talking about his philosphy, whether of radio or of life, Knapp's face rarely changes expression. While his non-stop voice is in full gear, Knapp only occasionally moves his head or darts his blue eyes. He is also willing to talk anywhere, whether in the studio, cafeteria, walking down catacomb-like hallways or in his office--a messy, glorified closet with four walls totally covered with pictures, all of which probably mean something to him. Knapp's office made this writer feel right at home--it looks just like my bedroom.

Sitting in his friendly office, Knapp could have talked for days on end about radio. Anybody interested in radio could have listened to it all because, like his radio show, Chuck Knapp is earthy, honest and anything but dull. Here are a few excerpts:

"My whole philosophy is the Will Rodgers thing, just don't take yourself too seriously. Its the same way in radio. Work hard at what you do, understand as much as you

can, try to win but don't make winning everything because that Vince Lombardi theory is full of shit. There's all kinds of room for number two and number three.

"I'm into the Moody Blues, that's my group. The only thing they've ever sung about is people.

"In order to be really good on the air, you've got to be really secure in your own profession. And to be really secure in your own profession, you've got to be really secure in your own head....I think very definitely this is an insecure business and I think each individual guy on the air has to be 27 years old before he really grows up and becomes a man...All the philosophy I've ever read, like Schopenhauer, all the records I've ever heard like John Denver's "Rocky Mountain High" where he is talking about becoming a man, all of those things point to the number 27. Twenty seven is the year in a man's life, 27 most accurately represents the time where everything sort of falls together, all the dust and all the wheel spinning stops and settles down.

"Working 12-14 hours a day is pushing, but I enjoy pushing. Just doing it to get there is no fun at all. Its having fun along the way that counts.

"Every station I've ever worked for, every city I've ever worked in, I've had nothing but just great times, because that's my whole attitude. Somebody says to me 'how long are you going to stay?' I say that I'll stay until a) they throw me out, or b) until it doesn't feel good. There's no time limits on anything in my life.

"I don't see television growing anywhere as fast as radio. Television is a total cesspool of bullshit. There's nothing on TV at all with the possible exception of a few good documentaries and some pretty decent sports events, "In Concert," "Midnight Special" and a few things like maybe "Colombo" and "Sandford & Son." Everything else there is total horseshit. What a waste of time."

What does the future hold for Chuck Knapp? These remarks seem to sum it all up.

"I love change...I believe people gravitate, but I really do believe that you will be what you want to be in the end. You'll get to it. I think too many people have been caught up for too many years in the trip where they are working for a goal they are never going to reach before they are 50, and they've forgotten what this stretch here is all about. They've forgotten day to day living and day to day happiness. By the time they have gotten right to the clouds, sitting in a big chair of velvet, all of a sudden they say 'now I'm going to relax and enjoy life.' But they've forgotten how, or they have had a heart attack."

Will that happen to Chuck Knapp?

"I'll go back to Fergus and be a bum before I'll die of a heart attack at 50. It ain't worth it."□

TWIN CITIES ROCK

ROB SHERWOOD

Rob Sherwood is difficult to put into words. On the radio, the professional Rob Sherwood has to be heard to be believed. In person, for totally different reasons, the real Rob Sherwood has to be seen to be believed.

Rob Sherwood, the radio personality, is suppossed to be super-charged, hyper-active and obnoxious. He should have a dirty mind, with sexual innuendos dripping off a rapier-like tongue. But the real Rob Sherwood does not fit this description. The real Rob Sherwood does not look like Rob Sherwood "should" look, he does not talk like Rob Sherwood, he does not even sound like Rob Sherwood.

Sherwood himself freely admits that he "is not the same person that (he is) on the radio. That Rob Sherwood" he stated, "is not me. I'm me."

The real Rob Sherwood has soft skin, long dirty-blonde hair and talks rather slowly out of the side of his mouth. This rotund person is quite warm, friendly, erudite, honest and is willing to speak his mind. He also seems to possess a quiet self-confidence, a sort of warm glow from within, making it unnecessary for him to push himself upon anybody. In other words, he seems to have his head together, which almost comes as a disappointment. From Rob Sherwood most people would expect at least token insanity.

Rob Sherwood has been a fixture in Twin Cities radio since his arrival at WDGY in 1968. In his eight years in the Minneapolis-St. Paul market, Sherwood has successfully worked at three different rock stations and has the distinction of never having been fired from any radio station, no mean feat in a business with such a high attrition rate. During his 8 year stay, the Minneapolis-St. Paul radio market has progressed from a backwater status to being one of the most explosively powerful markets in the country. At the same time, Sherwood's own status has progressed from being "just a jock" to being program director of a radio station. The rise of these two, the local radio market and Rob Sherwood, is not co-incidental.

Sherwood has thrived throughout his eight years and three stations for one very simple reason. People listen to him.

Rob Sherwood is another of the many native Minnesotans who have successfully pursued a career in AM rock radio. Originally from Duluth, Rob Sherwood was performing in local theatre when he stumbled into radio, as he describes it. "I was in a play in Bloomington and one of the

people I was playing with was working on the scenery. I asked him 'what do you do for a living?' and he said 'I'm a disc jockey.' 'A disc jockey!' I thought, 'wow.' I was really impressed. And I asked him 'how did you become a disc jockey?', and he said that he went to Brown Institute, which was a disc jockey school. Ultimately that stuck in the back of my head. About six months later I saw Brown Institute and stopped in. They gave me the sales job. I signed up and went there."

After graduating from Brown, he returned to performing in local theatre "doing character parts

mostly, ranging from musical comedy to Greek trajedy." Then, as he describes it, "I got a call from Brown Institute saying that someone was interested in hiring me. In fact I did get the job...in Blithe, California." After roughly one year in California, Sherwood returned to Minnesota to host "The Uncle Rob Show" on an Austin television station. Sherwood then went on to be a rock jock at radio stations in Cedar Rapids, Iowa and Green Bay, Wisconsin.

His big break came in 1968 when he was hired as an evening jock on WDGY. The local contemporary radio market at that time consisted of just two rock stations, WDGY and KDWB. Sherwood describes his start at WDGY like this; "I had replaced a disc jockey who was pretty successful. His name was Jim Dandy and he had been quite a personality. I replaced him and even improved on the success he had made. I was very lucky. KDWB had some poor competition so I had an easy time of it."

Sherwood's results were immediate and substantial. While a night-time jock would be considered successful if he garnered an 8-10 percent share of the total audience, Sherwood was able to score ratings of over 30 percent of the total listeners at various times. After about one year of this kind of success, Rob received a lucrative offer from the competition. Here is the situation as he described it, "Dean Johnson, the program director at that time at KDWB, who was new himself, had been brought in to save the radio station, so to speak. They had done research on the market and one of their questions was 'what type of disc jockey should they have at night?' The consultants said that they should get a disc jockey that was very much like Rob Sherwood at WDGY. Dean Johnson said 'why get a disc jockey like Rob Sherwood? Why not get Rob Sherwood?'" After KDWB tossed in a bonus, an air-tight contract and a trip around the world, Sherwood accepted their offer and spent the next five years as the evening jock at KDWB. While WDGY and KDWB battled back and forth to see who would come out on top in the ratings, Sherwood's record at KDWB was consistently successful. Although he was enjoying consistent success at KDWB, after a while Sherwood felt that his career and personal development stopped progressing. "I became very complacent, very settled, very content," Sherwood observed. "Hey!, KDWB was a magic place to work. I went to work at 5:30. I was home by 10:30. I was winning without really working hard at it. I made good money, they were good people to work for, no reason for me to leave. Because of that, my career, for a few years, stifled itself. I became too contented." That contentment was shattered by events in late 1973 and early 1974, as amended working conditions dictated that a major change was in the works for Rob Sherwood. Leaning back in a chair in his half-completed office, Sherwood recounted those circumstances. "After working at KDWB as a jock for all those years I was, quite frankly, starting to feel a little trapped. I was doing the same thing--being a teeny-bopper night time rock jock. My ratings had been very good, but we had recently been raped by KSTP. The program director left and I said 'Hey! I'd like to be program director.' That was the first time it had come into my mind that I wanted to enter into management and quit being 'just a jock.' A man named Bob Shannon, who was morning man at the station, got the job. I did not get it and from that point on I must say that it was a hellish place to work. Shannon was going to let me know that I had no right to even ask for that job, no right to compete with him. There was a lot of swearing , a lot of yelling and eventually I decided 'this was it' and I resigned. Three weeks notice."

After logging his last chapter for KDWB, Sherwood did a complete turnabout. From a radio career exclusively devoted to being a rock jock, Rob Sherwood, teeny-bopper empressario, became the program director and disc jockey of WYOO, a middle-of-the-road, oldies radio station. At the time he was hired, April, 1974, the 28 year old Sherwood fully intended to shift gears and continue the oldies format of WYOO. "I was convincing myself that I was going to change completely and become an adult personality. I was very serious about this," he noted, "but even though we made a valiant effort to make the oldies format work, there was no salvaging it. It was just doomed to failure," he said, while toying with a razor blade he had just used to try and repair a faulty headphone.

So Rob Sherwood decided to do what Rob Sherwood does best--rock.

In August of 1974 WYOO, which meant "oldies" became U100, which meant "boogie", a rock music term general enough to fit virtually any definition. As a program director, Sherwood pointed out some of the specific effects necessary for success. "Little things that we used were the illusionary things--the illusion of playing more music, the illusion of not playing bubble-gum, the illusion of playing album cuts, the actual, factual thing of being in stereo and being a very sassy radio station, a very smart-assed radio station. We had to approach this market in order to make people aware of us very very quickly. We could not wait for them to get used to us. We had to pound it into them.

The results so far have been very promising. While encountering some skepticism at first, U100 has steadily grown. From a rather modest beginning, Sherwood's baby has grown to the point where the last ratings showed U100 drawing more 12-17 year olds than any other station in the metropolitan market. In the 18-34 age category, in the metropoltan area, U100 just barely outdrew both KDWB and WDGY. Not bad for an upstart station.

So success does seem to follow Rob Sherwood. It is rather difficult to assess the exact reasons for this but it is conceivable that Rob Sherwood is as notorious as he is popular. Rob Sherwood's voice and on-the-air presentations are both identifiable and very memorable. His style is far more than just distinctive. Rob Sherwood makes his listeners react to him, in one way or another. That voice of his almost seems to reach out of your radio and grab you, the listener, by the throat. You are either forced to surrender to him and boogie along, or fight him by trying, usually in vain, to tune him out mentally. That is extremely difficult to do--Rob Sherwood is very difficult to ignore. This is probably what makes him so popular, or notorious, depending on your individual tastes.

The professional Rob Sherwood is suppossed to be an egomaniac. However, the real Rob Sherwood appears to be devoid of any superfluous ego. While munching on a Colonel Sanders Country Style Rib which he copped from someone in the outer office, Sherwood leaned forward and gave an erudite dissertation on the positive value of egos, including an explanation of his own professional one: "In this business the only refuge the individual has is in his own ego. The worst thing in the world is to have that ego shattered. You build a little shell around yourself, and your ego protects that shell. Maybe a part of that shell is good ratings and another part is making good money and another part is paying your bills on time. Okay, so that's your shell, that's what you've created for yourself. Helping to create that shell have been things like groupies calling you up, saying how neat you are, or your parents being proud of you. Then all of a sudden the ratings come out and you just got killed, or some kid calls you up at the radio station and says 'you suck.' Then a little crack appears in your shell. Your ego is what keeps that little crack from destroying your whole shell. Your ego is like glue, it is like cement. If some kid says' 'you're terrible,' you sit there and say 'what do I care about what he says? I'm the one who drives the big car. I'm the one who makes the decent salary. I'm the one with the disc jockey show.' So you use your ego to protect yourself. You have to, otherwise you would go crazy."

Ego, like anything else, can have it's bad points and limitations, as Sherwood is quick to point out. "Ego is a very important part of this business. The only thing I see wrong with the ego thing is when it interferes with your growth within your chosen career.Then, of course, it has traveled beyond the bounds that it should--when people become so egotistical that they refuse to accept any form of criticism, and of course thats not good. I've worked with people like that and at times I've probably been guilty of that myself. Ego is good, but not when it interferes with the learning process."

The real Rob Sherwood--the human being with the same feelings, drives and emotions that all of us possess--is a private person, as is his right to be. Whether or not he is a success in that area is his own business.

But the professional Rob Sherwood, the super-high-energy jock, the always laughing, happy, booging voice on U100 can most definitely be judged. By all professional standards, whether you like him or not, Rob Sherwood is quite a success story. In fact, he has been so successful that you might call it outrageous. □

TWIN CITIES ROCK

WHO WILL DROP?

The Twin Cities are hot. Only a few years ago, this area was only a secondary radio market. Suddenly, that situation changed for the better.

A relative newcomer to the Twin Cities, John Sebastian is the program director at KDWB. He describes the Twin Cities radio market in this way; "this is a very interesting market, unique in the country, really, in that it is recognized as probably the most competitive radio market in America." Sebastian goes on to point out why this is such a hot market. "There are four AM rockers in this town. This is a rare situation. For example, in New York City there is one. In Los Angeles there is one AM rocker. In Chicago there are two. In Detroit there are two. In Minneapolis-St. Paul, with two and a half million people in the total survey area, we have four AM rockers, plus the domination of WCCO-AM which has, at times, 50 percent of the entire audience. Everybody else splits up the rest."

Can everybody else split up the rest of the audience and survive? We asked the question **Can four AM rockers survive in this market?** to the program directors of the four AM rock stations. Their response was almost unanimous--four AM rockers cannot survive here over a long period of time. "Its just not in the cards," says Johnny Canton, program director at WDGY. "There is not enough audience to go around to pay the bills. Eventually, somebody will have to give," he said. Chuck Knapp, program director at KSTP agrees with this assessment. "I've seen situations like this in other markets," he said. "They never last." John Sebastian echoes these sentiments, adding "four AM rockers can survive but nobody will be making any money except for WCCO and maybe WAYL. Everybody else will just be cutting each other's throats.

Only Rob Sherwood, program director at WYOO-U100 believes that four AM rockers can turn a profit, although he is lukewarm on the prospects for long-term survival for all four. As he put it, "no radio station is successful unless its got a black bottom line. I don't care if your ratings are great or whether you've got everyone listening to you, or whatever. You've got to have the revenue--to be making money. Can four (AM rockers) make money? I think its possible," he stated.

If this market cannot sustain four AM rock stations, then the obvious question that arises is **Which of the four AM rockers will drop?**. We posed this question to the four AM rock station program directors. Here are their comments on the subject.

CHUCK KNAPP: About the most positive thing about this radio market is whats happened to it in the last three years. KSTP played a big part in that. And Buzzy Bennett came to KDWB and played a part in it. U100 is playing a good part in it. Really, the only station that has slid and has not done too much is WDGY and I don't think they are going to slide too much longer.

ROB SHERWOOD: For WDGY to change format is virtually inconceivable. But one of the other things you have to say about WDGY and Storz Broadcasting (the parent company of WDGY) is that if you look at their position in the markets they are in all over the country, it's my opinion that they are in trouble everyplace. They don't have a number one station anyplace. In some markets their stations are so far back in the pack that its incredible. Thats because they have been having competition but they have not been meeting it.

So if their ratings are consistently bad over a two or three year period, are they going to drop? Maybe, but who can say? But if they did it would be a real reversal in history.

JOHNNY CANTON: We began it

TRUE DON BLEAU & JOHN SEBASTIAN

Can Four AM Rock Stations Survive in the Twin Cities ?

(rock format) here and even though we may take periodic setbacks in the ratings--we are experiencing one right now and we have been for awhile--we do not plan to change the entire staff or make any major changes in our format because it is not necessary.

It all comes down to staying power. We can outlast anybody because of our company. It is a strong, solvent company and they do not plan to change. So as long as they have that kind of faith in us, all we have to do is comply and to justify that faith in us, to do the format the best way we know how.

JOHN SEBASTIAN: For the last five books (Arbitron audience ratings) WDGY has looked terrible. WDGY at one time was a dominant factor. At least they were the number one rocker.

ROB SHERWOOD: My impression of WDGY is of great potential. That station has been around a long, long time. Their call letter identification is just huge. I would say that their problem has been a lack of promotion and they don't relate very well to the current market.

I see no reason not to believe that it could be a super radio station. I think they have been greedy and cheap in the last few years.

JOHNNY CANTON: What killed us in the first place is that we got a bit greedy. Two years ago, when there was a price freeze, KSTP entered the rock market by playing two minutes of commercials an hour. We had been playing 18 minutes an hour. Because we were in a price freeze, we could not raise our advertising rates and lower the number of our commercials. Both KDWB and ourselves got hit pretty hard in the ratings.

JOHN SEBASTIAN: I am sure that they (WDGY) would agree that if they had better ARB's (better ratings), that they would be making more money than they are now.

JOHNNY CANTON: I dare say that we would be making a few more dollars if our ratings were higher. But I cannot submit to you that we are in real trouble. If anything, we are optimistic about the future, and we have the backing of a very solvent corporation.

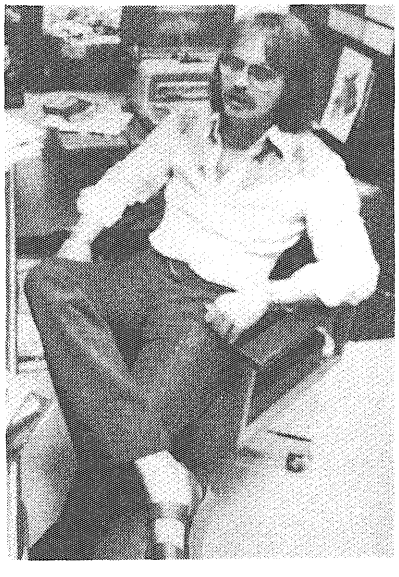
ROB SHERWOOD: WDGY is in the black because they don't spend any money anyplace else.

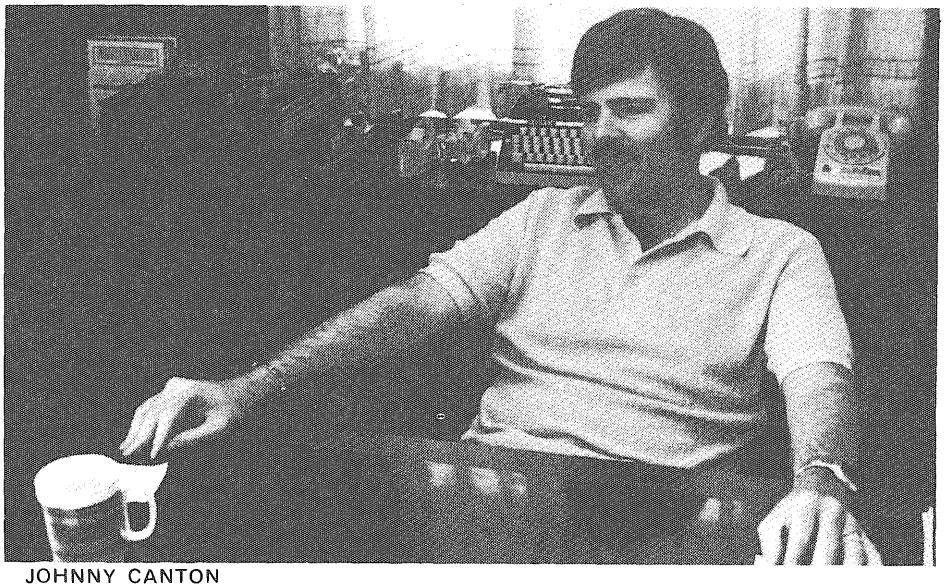
JOHNNY CANTON: We are blessed with a very agressive sales staff who can go out and sell this radio station under the most severe circumstances. That is what they are doing right now because WDGY has a certain amount of longevity in the market ...as a matter of fact, it is the oldest station in Minnesota and it is certainly the oldest contemporary radio station.

CHUCK KNAPP: I have heard that WDGY has a really good sales staff, people who have been in this community for a long time and have worked hard to establish good contacts. I think that is a definitely valid point.

JOHN SEBASTIAN: I have found that any station that is doing very poorly in the ARB (ratings) will immediately say that they do not need ARB, that we can live on our reputation. And that's true, WDGY still gets by because they are familiar and they've been rocking. If that's satisfactory to them, thats fine.

JOHNNY CANTON: Regardless of the ratings, several advertising people buy strictly off of credibility--what a station can do for them regardless of what the ratings say. One example is an automotive dealer. He only buys us, based upon the results he attains. And he spends a lot of money a year--I mean thousands. He has no reason to change. He has been asked by several radio stations who will come in and throw the (ratings) book around,





JOHNNY CANTON

but he does not want to even look at it because he gets excellent results from WDGY, and thats the bottom line with him too.

JOHN SEBASTIAN: They (WDGY) probably will not fold financially because they do have that familiar thing. And it is true that old line advertisers will buy WDGY just because it's 'good old WDGY.'

CHUCK KNAPP: I don't know what the problem with that company (Storz Broadcasting) is, but it ain't John Canton. It is way above that. Somebody up there in the driver's seat has gotten sloppy, loose and old. Anytime Storz wants to get off it's dead ass and start promoting, and start running, they'll do very well. But for now, they've just sat back and gotten fat. Fat cats get knocked off.

JOHNNY CANTON: I can't see that we are 'in trouble.' I think that radio in general is in trouble, in terms of revenue. The economy dictates that revenues are somewhat down. But we have a situation in which every station in this market will have to withstand until the economy turns around. It all goes back to staying power.

How long will a Doubleday, for example, sustain the losses that they are supposedly sustaining right now with KDWB before they decide to sell it or change format?

JOHN SEBASTIAN: With the current fragmentation, there is no way that any of the rockers can really be dominant. What we are striving to do now is just to win. Just to barely eke out a survival and be the number one rocker. That is our goal.

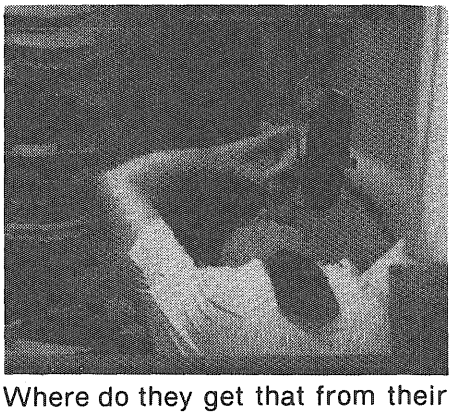
ROB SHERWOOD: They (KDWB) would have no problem making money but they spend money rather foolishly.

CHUCK KNAPP: KDWB brought in one of the greatest slammers of all time to slam this place (KSTP). They brought him in last April. His name was Buzz Bennett. I really like Buzz, he and I are good friends. As a program director he is a master of psyche. Buzzy took one of the most serious runs thats been taken anywhere in the country at the top station, and he didn't make it. I think he over-hyped, thats my own personal opinion, even though he took then from a bad number six to what I would term a good number three in the ratings.

JOHN SEBASTIAN: There's a lot of research that goes into programming the music. I would say that 99 percent of the people don't believe it goes on.

As play all of our music according to a criteria established by requests that we get at the station. We ask people questions ...we also do detailed album and 45 sales reports from the top record stores in town. We subscribe to every major trade paper in the industry. We use all these as a kind of mellowing effect to make sure we are somewhere within the framework of what's happening nationally.

ROB SHERWOOD: I have a lot of love for those call letters (KDWB) because I worked there for so long, but the radio station is not what it once was. I think its main problem is that it's a kind of bland radio station, being run by people who don't relate to this market particularly well. They supposedly do a lot of relating to this market, but I always ask them, for example, why do they play black music?



Where do they get that from their research?

We do a tremendous amount of research, easily as much as they do. No matter what I do, I cannot get any research that indicates that people in this market want to hear black music. I can't get any research to indicate that people over the ago of 16-17 want to hear bubble-gum music. But all you have to do is turn on the radio station and see what they're doing. If they're taking research, they are ignoring it, or they're doing it differently than I'm doing it.

JOHNNY CANTON: I don't know where KDWB is going. I think they,ll be all over the lot (in) the (next ratings) book. They're tough to figure out.

CHUCK KNAPP: I don't know what to think of KDWB. I think they'll probably stay because they've been in third place here now, and in third place you can make pretty good money.

ROB SHERWOOD: KSTP, of course, is an absolute phenomenon--they destroyed every radio station, completely ripped them apart and because of that, achieved a place of dominance very, very quickly. I don't think the radio station is the same as it was three years ago. They are attempting to hold onto what they got with something different from what got it for them. That is my opinion of what their basic weakness is, if they have one.

CHUCK KNAPP: U100 is coming up. They've done a nice number for a suburban Ritchfield station with a somewhat crummy AM facility.

JOHNNY CANTON: I would have to think that U100 has got to have practically every teenager in town listening to them.

CHUCK KNAPP: U100 looks to be more solid than ever. This ARB (ratings measurement) will be very important to them. Last fall they did fair, last winter they came on a bit better and if they continue to come on just a little bit more, I would anticipate them staying.

ROB SHERWOOD: We are very close to being a successful radio station on a revenue basis. I would say that by the middle of the summer, you would have every rock radio station in the Twin Cities in the black.

The ultimate decision as to which Twin CitiesAM rocker, if any, will change format would come sometime after June 20. That is the projected date when the next ARB ratings will come out.

In terms of radio listeners, Chuck Knapp states what would be the most beneficial situation for you and me; "the more stations you get in a market, the better the competition. The tougher the competition, the better it is for the entire radio audience. Minneapolis radio is one of the hottest markets in the country which means that it's good for music, it's good for artists and it's good for people who like to listen to the radio. And it will draw more people into listening to radio."

Anyone for a fifth?

INFINITY

(It can be fun)

by Jon Nelson
and Jim Young

Human beings have been aware of something called infinity for about 2500 years or so. But perhaps only one man has really intuitively understood the idea--Georg Cantor--and it drove him mad.

Infinity does not exist in nature, as far as anyone can tell. That fact suggests why infinity is so wierd, as it is merely a concept dreamed up by the human mind. Remembering that most mathematics is simply a series of ideas thought up within special rules, infinity and most pure mathematics can be thought of as a game. The object of the game of mathematics is to be as general (but theoretically provable) as possible. This notion led Bertrand Russell to say, "...mathematics may be defined as the subject in which we never know what we are talking about, nor whether what we are saying is true. People who have been puzzled by the beginnings of mathematics will, I hope, find comfort in this definition.. .." (In "Mathematics and the Metaphysicians," in J. Newman, ed., **The World of Mathematics** (New York, 1956), III, p. 1577.).

Infinity is the sort of topic which makes nearly everyone agree--if only for a moment--with Russell. This year it isn't being talked about in Analysis III here at Minnesota, but usually a certain solid of revolution usually comes up in Freshman Calculus which suggests how odd infinity really is. The solid is created by rotating the graph of the function $f(x) = (1/x^2)$ about the x-axis; we will talk only about the function at values of x greater or equal to one. Now if you analyze the solid, you'll find that it has a finite volume, but an **infinitely** large surface area.

How can this be? First, the volume is given by the integral

$$\pi \int_1^\infty \frac{1}{x^2}\, dx$$

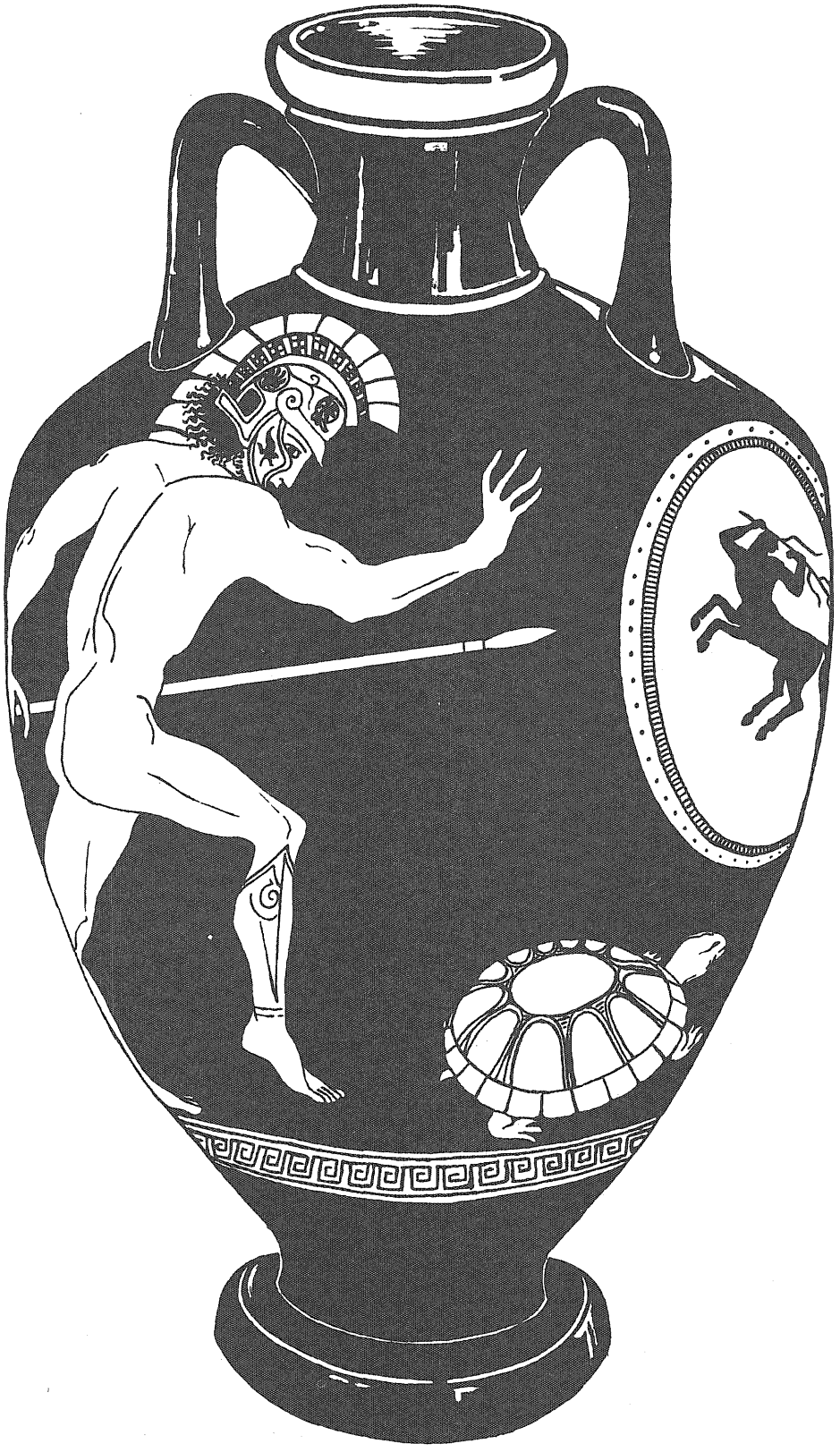
which is equal to π. Now the surface area of this solid is given by the integral

$$2\pi \int_1^\infty \frac{1}{x} \sqrt{1 + x^{-4}}\, dx$$

which is infinite! That means a given volume of paint, say 3.1415... ounces, would fit inside an infinitely surfaced container. Since the paint would fill the container, it would also cover an infinite surface....

Nothing, we contend, will make it easy to understand how this can be, so we do not include a picture of the figure in order to keep up our reputation as a high class magazine.

Infinity is difficult to visualize



because you do not have an intuitive grasp of the infinity concept. Don't worry about it, unless you want to end up like poor Cantor (who really died in an asylum in 1918). Besides, you are in the great company of several famous people who also did not intuitively understand infinity but who could deal with it. One of these men was the ancient Greek, Zeno of Elia (who lived about 450 B.C.).

it is really Zeno who first brought infinity to the attention of the world. (It has subsequently become one of the great topics of debate in all university towns the world over. Every year, we are told, the **Big Ten** has to break up three or four scuffles generated by arguments over infinity.) Zeno loved to ask questions which no one could answer; these were called paradoxes (which is Attic Greek for "I don't know what you're talking about.") Zeno posed four famous paradoxes concerning infinity, The Dichotomy, The Arrow, The Stadium, and The Problem of Achilles and the Tortoise.

Now Achilles was the greatest athlete in ancient Greek legend. He wasn't especially well-heeled, but he could outrun anyone (including his creditors). So Zeno asked what would happen if Achilles were asked to race a tortoise. All bets were on Achilles in this race, but Zeno set out to show that Achilles would never win.

Zeno said, let Achilles race the turtle along a straight path. Since the tortoise will be much slower than Achilles, give the little guy a handicap; let the turtle start at the halfway point. Then when Achilles reaches the halfway point, he will find that the tortoise has made it to the three-quarters point. When Achilles makes it to the three-quarters mark, the turtle will be half again as far away. If this continues, then Achilles will never quite reach the animal, nor will he ever overtake it in the race. This is because any line can be subdivided any number of times; Zeno happened to be fond of cutting things in half, something he did in his other paradoxes too. Zeno's purpose in all of this was to

prove that there was no such thing as motion; thus in The Arrow, he showed that the trajectory of an arrow could be halved indefinitely, and therefore showed to his own satisfaction that the arrow could never reach the target at which it was aimed. His other paradoxes were similar in nature.

Infinity raised its ugly head a few years later when Newton and Leibnitz met at a coffeehouse in Brussels to invent the calculus.

"Newt," said Leibnitz, "we can take the derivative--what you call a 'fluxion'-- of this here function if we let H be a fraction which is bigger than zero but which isequalto zero. What do you think?"

Leibnitz had written had written down the following formula on a napkin:

$$\frac{f(x+H)-f(x)}{H} = \frac{dy}{dx} = \dot{x}$$

"Yup, it sounds good to me, George," was Newton's reply. He was fond of calling people George.

This is not quite the way it happened, mind you, but it is essentially what Newton and Leibnitz thought of when they spoke of the infinitessimal. The religious philosopher Bishop Berkeley poked such fun at the concept of the infinitessimal that it was discredited during the mid-1700s. Even Berkeley (whose name was pronounced "Bark-ly"), who had no formal mathematical training, could see that a fraction greater than but equal to zero was nonsense. (This did not prevent Bishop Berkeley from writing nonsense of his own, however; he was the one who first asked what happens to a tree which falls in a forest, when no one is around to hear it. Berkeley said it doesn't exist-- except in the mind of God, where al things exist. It was not until the last half of the 19th century that a man named Weierstrass invented one way to prove that derivatives exist without the need for an "Infinitessimal." Weierstrass developed the infamous delta-epsilon proof method, which is the bane of all first quarter calculus students in the West. Recently, by the way, it has been shown that Weierstrassian delta-epsilon proofs (which have certain flaws to them) can be relegated to a mathematical dusty closet. The details are not available yet, but evidently the proof for the fundamental theory of differential calculus can be done through set theory. When told of this recently, a mathematical friend of ours (who had not heard of the new method(said, "Ye Gods! I don't know which I hate more, Weierstrass or set-theory." This is evidence of the singular devotion and love which all mathematicians show towards their field.

To illustrate how Cantor got hold of the notion of infinity, it is perhaps best to rely on an anecdote. This story was told by David Hilbert, who was one of the most brilliant of German mathematicians. (The story is taken from George Gamow's wonderful book, **One, Two, Three... Infinity** (New York, 1947).) Hilbert used to say in his lectures on Cantor that you should imagine a hotel with a finite number of rooms, all of them occupied. If someone should arrive without a reservation to ask for a room, the night-manager (in the grand tradition of all hotel night-managers) would say, "Sorry, we're full."

Now, says Hilbert, imagine a hotel with an infinite number of rooms, all of them occupied. After finding no room available in the finite hotel, the fellow without a room-reservation comes to the infinite hotel to ask for a room.

The night-manager says, "Mais oui! But of course." He promptly moves the fellow in room N1 into room N2, and the woman opera singer in N2 hollars while being moved to room N3, and so forth. But the new customer gets into room N1, which became free as the result of moving everyone down one room.

"Let us imagine now a hotel with an infinite number of rooms, all taken up, and an infinite number of new guests who come in and ask for rooms.

"Certainly, gentlemen" says the proprietor, "just wait a minute."

"He moves the occupant of N1 into N2, the occupant of N2 into N4, the occupant of N3 into N6, and so on and so on....

"Now all odd-numbered rooms become free and the infinity of new guests can easily be accomodated in them."

Georg Cantor proved--not quite in Hilbert's way, but by much similar thinking--that there are an infinite number of types of infinity. As if the idea of infinity were not in itself enough, Cantor went on until he had ranks of infinities (which he termed aleph-null, aleph-one, on to aleph-n --the aleph being the first letter of the Hebrew alphabet . (This, according to all reports, is what finally made the great man's mind snap. When he began to investigate infinite series of bananas growing in the Berlin Tiergarten, he was locked up. (It was a well-known fact at this time that the German Emporer did not like bananas, so there is the possibility that it may have been a political ruse.) It is a telling point, however, that Cantor was not in Berlin at the time.

As we said before, the major reason why infinity is such a strange concept is that it has no parallel in the physical universe. It is for that reason a part of pure, rather than of applied, mathematics. Traditionally, therefore, it is the sign of a faulty theory in physics if infinity appears in any equation.

Well then, you ask, why worry about infinity? The question is certainly a valid one--but it has no ready answer. Those people who are worried about infinity worry from philosophical grounds--to wit, why does infinity keep popping up in mathematics if it has nothing to do with reality? We suggest that there is no easy answer to this question, either. But David Hilbert provides one answer: when he spoke before a world congress of pure and applied mathematicians in 1900, he opened the conference by saying, "Ladies and Gentlemen, I have been asked to talk about the relationship between pure and applied mathematics. Well, there is none." And with that he is reported to have left the stage. As do we.□

realtoys T.M.

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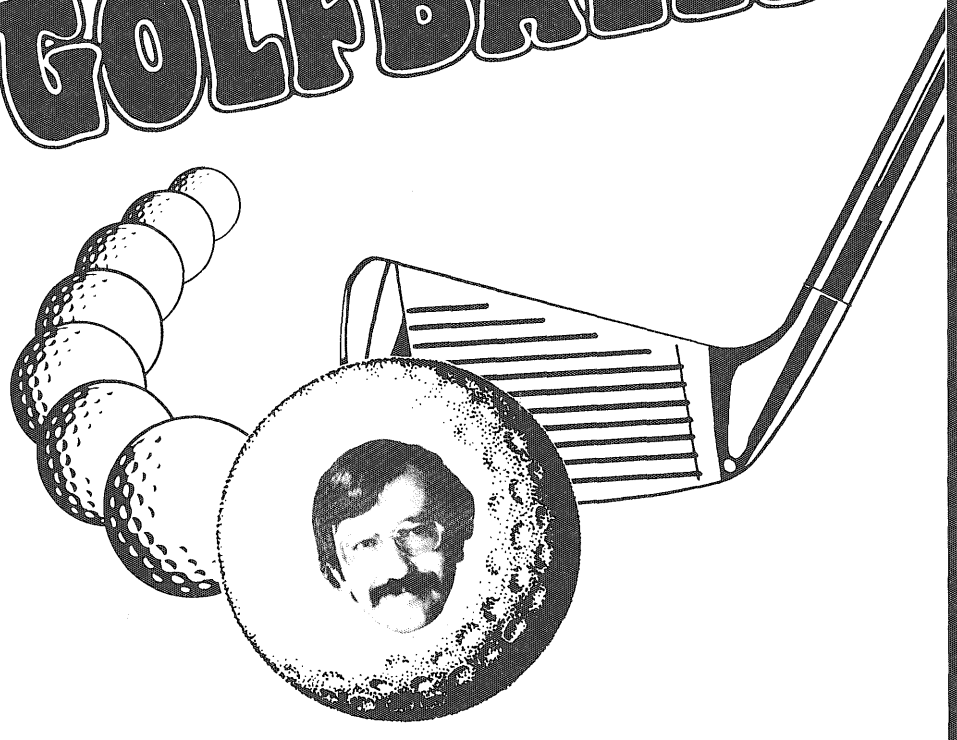

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