TECHNOLOG

UNIVERSITY OF MINNESOTA OCTOBER, 1970

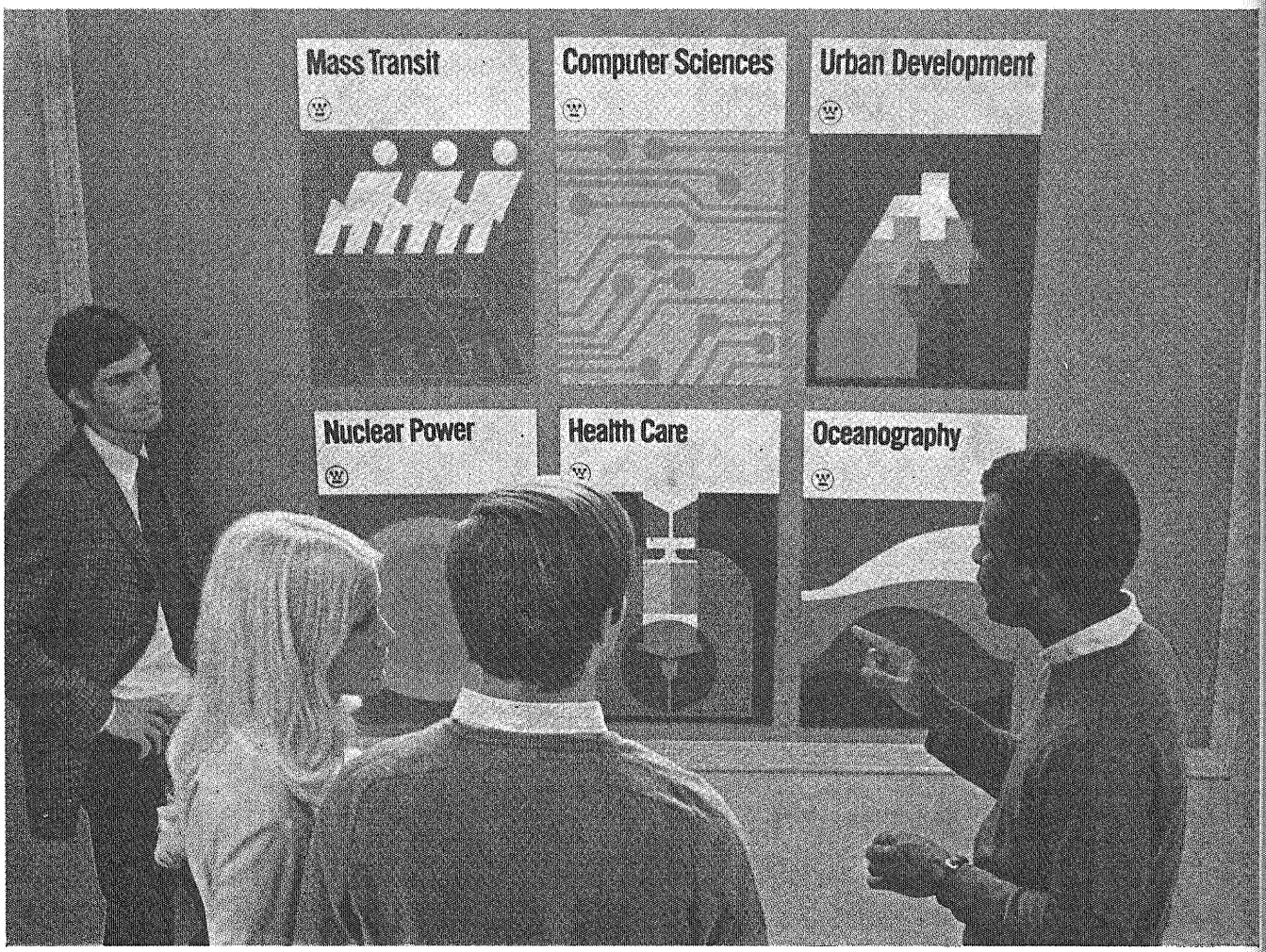
MINNESOTA TECHNO-LOG

Vol. 1 November 1920 No. 1

IN THIS ISSUE

Published monthly during the school year
by the students of
The College of Engineering & Architecture & the School of Chemistry
University of Minnesota

If you want to engineer a better world...



a great place to start is with one of the most diversified companies in the world.

Westinghouse thinks its responsibilities are as big as its capabilities—and that's big.

And when you're in everything from computers to urban development, to medical science, to mass transit, to oceanography—there's action. For example...

Transportation: Our computerized transit systems can operate on a 90-second schedule, and meet the transportation needs of many cities.

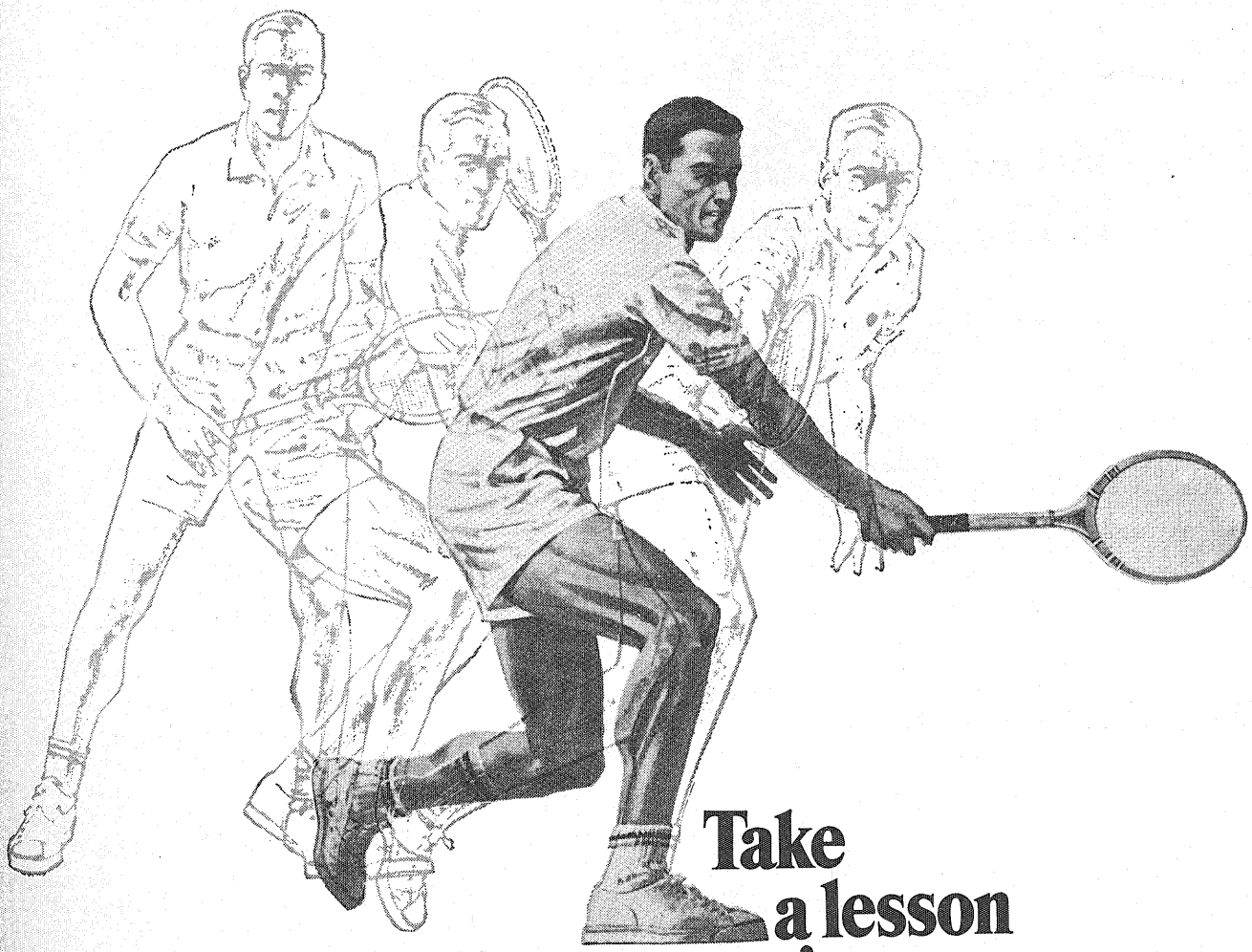
Urban Development: Our new construction concepts will provide better communities across the country. Projects are planned or underway in 30 major cities.

Health Care: We are using a systems approach to provide better medical care for more people. Example: electronic equipment that lets nurses monitor the hearts of eight patients simultaneously.

Nuclear Power: Westinghouse leads the way in nuclear power generation. Seven nuclear plants in operation, 34 in various stages of design. We're working on a breeder reactor to keep us ahead.

That's a sampling. We're just getting started. If you'd like to help us engineer a better world, talk with our campus recruiter. Or write Luke Noggle, Westinghouse Education Center, Pittsburgh, Pa. 15221. An equal opportunity employer.

You can be sure...if it's Westinghouse



Take a lesson from a tennis pro.

A tennis champion's powerful backhand looks as smooth and unhurried as a ballerina's graceful bow. How's he do it? By being in the right position in plenty of time.

"Remember this about the backhand," the pros advise. "Get both feet around pointing toward the sideline. And always make sure the right foot's forward, so your body doesn't cramp your swing."

Getting into proper position early is good advice for college seniors, too. Here's the first step:

When companies interview on your campus, make sure they interview you. When The Timken Company representative stops by, don't let him go without seeing you.

He'll fill you in on our work (maybe your work) with the aerospace, automotive, construction, chemical industries. Our openings in production, engineering, sales, finance, metallurgy.

So you won't get caught flat footed when it's your turn to make your move. The Timken Company, Canton, Ohio 44706.

Timken® bearings sold in 133 countries. Manufacturing in Australia, Brazil, Canada, England, France, South Africa and U.S.A.

An Equal Opportunity Employer (m/f).

On your campus...

November 16, 1970

A Timken Company representative would like to talk with you!

TIMKEN®

REGISTERED TRADEMARK

THE TIMKEN COMPANY MANUFACTURES TAPERED ROLLER BEARINGS, FINE ALLOY STEEL AND REMOVABLE ROCK BITS.

TECHNOLOG

VOL. 51, NO. 1 | Official Student Publication of the Institute of Technology, University of Minnesota | OCTOBER 1970

FEATURES

DEPARTMENTS

ABOUT THE COVER: FOR OUR 50TH ANNIVERSARY THE COVER SHOWS OUR FIRST ISSUE PUBLISHED IN 1920.

MEMBER OF ECMA

Published monthly, October through May. Second-class postage paid at Minneapolis, Minnesota. Office: Room 2, Mechanical Engineering Building, University of Minnesota, Minneapolis, Minnesota 55455. Telephone: 373-3298. Printer: Bruce Publishing Co., 2642 University Avenue, Saint Paul, Minnesota 55114. Publisher's National Representative: Littell-Murray-Barnhill, Inc., 369 Lexington Avenue, New York, New York 10017 and 737 North Michigan Avenue, Chicago, Illinois 60611. Publisher's State and Local Representative: University Engineering Magazine Advertising, F. P. McGrath Manager, Box 14026 University Station, Minneapolis, Minnesota. Telephone 612-225-0708. Member of the Engineering College Magazines Associated, Gordon Smith, Oklahoma State University, Stillwater, Oklahoma. Subscription rate: $3.00 per year, single copies 50 cents. Advertising rates upon request. Any opinions expressed herein are not necessarily those of the Institute of Technology or of the University of Minnesota.

EDITORIAL STAFF

Marvin Vikla ..... Co-Editors
Frank Collins .....

Don Neal ..... Photo Editor
Bruce Wright ..... Art Editor
Marina Braun ..... Staff
Barry Bridges ..... Photos
Mike Chase ..... Staff
Barry Johansen ..... Staff
Brian Johnson ..... Photos
Bill Loye ..... Staff
Jay McFeters ..... Staff
Steve Nelson ..... Art
Becky Phillipps ..... Staff
Ron Reichenberger ..... Staff

BUSINESS STAFF

JoAnn Hanson ..... Business Manager

Steve Swanson ..... Circulation Manager
Shim Adesina ..... Staff
Ralph Polkinghorne ..... Staff

ADVISORS

Paul A. Cartwright
LeRoy C. Ponto
Clifford I. Haga
Donald G. Herron

50 Years 1920–1970

By Rodger Whipple

Fifty years ago this fall, the *Minnesota Techno-log,* as it was then known, began its existence as a simple, friendly little book that kept the engineering students up to date on the latest gossip of current and past students, and the latest engineering advances.

Actually, the *Techno-log* was not the first publication published by the engineering students. The *Yearbook of the Society of Engineers* appeared in 1893 and was an annual chronicle of the Society of Engineers' activities in the College of Engineering, Metallurgy and Mechanic Arts. After 15 years, the engineers found that they had too much to say and not enough opportunity to say it, so the quarterly publication, the *Minnesota Engineer,* emerged in November 1908. An editorial in the first issue stated the magazine's purpose: "The object of this publication is three fold; fiirst to be the official organ of the Engineer's Society; second to be a means of presenting to the public, the technical articles by alumni, students, and others; and third to contain current and alumni news."

In 1915, lack of interest forced the suspension of the *Minnesota Engineer;* the publication of the Minnesota Society of Professional Engineers now carries this title. After the reorganization of the Society of Engineers into the Association of Engineering Students, the new student group decided to get back into the magazine business, and the *Minnesota Techno-log* was the happy result in 1920.

While the University was smaller and slower paced, the students of that day must not have been much different from those of today (shorter hair maybe). The first issue started the *Technolog* humor tradition, which has been almost unbroken for fifty years. Samples of the humor:

> A letter from O. Goode states that he and his wife enjoyed a visit from Mr. and Mrs. O. U. Stone. While they were on their way to the train they passed thru a very exciting accident which might have badly injured Oscar had he been riding on the bumper in the place of in the back seat. While driving along the highway, a cow jumped the fence and ran in front of the car, and before the car could be stopped it struck the cow between the two fences, badly breaking the lamps, fenders, and radiators.
>
> Professor lecturing to the class on the mysteries of Electricity: "We don't know very much when we really test ourselves, do we? Take for example 'Force.' We know the reaction; the results; but do we know the thing itself; can we see it? Has any one present ever seen a Force?"
>
> A Junior: "Yes sir, a Police Force."
>
> Such was the state of humor in the twenties.

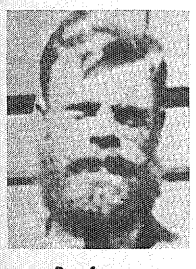
However, in the same school year the lead article in the June issue demonstrated great concern about pol

At left are a few of the many awards presented to the Techno-log over the past fifty years.

lution in the Mississippi River.

Through the twenties and well into the thirties, the *Technolog* did not change much, at least as far as reading matter was concerned. More and more pictures began appearing, but heavy emphasis was still on alumni, and local and practical engineering news and articles.

In the mid-thirties, a young instructor, sporting a full beard, began reviewing books for *Technolog* readers; Professor Haga is still in the *Technolog* today, contributing his sage advice as a faculty advisor. The C. E.'s annual report of their summer camp excursions to Cass Lake was also a perennial feature. The end of the thirties saw more articles about the stepped up activities in pre-war industry. And as the engineering and science student body grew, the magazine was less folksy, publishing less about the alumni and clubs. However, the first issues in 1937 shocked the student body with its modern image: jazzy layout, more pictures, color—things only a magazine editor could love.



Professor Haga

The forties meant war, but the *'Log* did not cease publication; it contributed its share of moral boosting articles and reassuring advertisements. After the war, the veterans flocked to campus and the *Technolog* moved to meet their needs with the introduction of the pin-up girl.

The fifties saw a succession of crises which, for a time, seemed about to send the *'Log* the way of the Ski-U-Mah. The February 1953 issue contained a parody of the Ivory Tower, the campus literary magazine, and a page of apparently off-color jokes. Unfortunately, the Dean of Students, with the Student Activities Bureau and a faculty senate committee took exception to the jokes and the parody. While the magazines sat in their boxes, the controversy stormed. Finally, the governing board of the Technolog decided to distribute the magazines with an insert explaining the problem. The next step of the faculty senate committee was to ban humor in the *Technolog* for an indeterminate time. And not until the following year, and after a new governing constitution was written, was humor restored to the *'Log*.

The remainder of the decade saw an editor replaced for extreme procrastination in his duties, the dwindling finances due to poor management, and less advertising revenue. As a money making project and as a gesture to the fans of *Technolog* humor, the first annual humor edition was published. It was fun filled and profitable success and continued for a number of years, until finances were more stable and the student body seemed to mature.

That brings us up to the start of our 50th year as the official publication of the Institute of Technology and the *'Log* expects to have a few more birthdays. Of course, you can help celebrate this one by reading the magazine—and not just the jokes! But if you really want to help, come on down and join the staff.

Above: A cover from a past humor edition.

Post-War Pin-Up

1940: Boeing designs the 'Flying Fortress,' and Clearprint is there. (Today, they're designing passenger jets on the exact same paper.)

Why haven't we changed Clearprint paper since 'Flying Fortress' days? Because in 1933 we developed a proprietary process that still gives Clearprint the world's finest ink and pencil surface. An uncoated surface for superior erasability and strength. A surface that won't erode, ghost, crack, or yellow with age.

Clearprint drawings are now making clear reproductions even after 20 or 30 years. When a single piece of drafting paper may hold thousands of dollars worth of man-hours, that permanence is essential.

With Clearprint paper, you never have to worry. That's why we haven't changed it since 1933.

So if you're planning something memorable, do it on Clearprint paper. You will do it well.

The Boeing B-17C (top, opposite page): First 'Flying Fortress' to see combat, in RAF high-altitude missions over Nazi-occupied Europe. Speed, 300 mph. Ceiling, 36,000 feet. Range, 3,400 miles.
One in a series covering historic Clearprint design events.

Clearprint Paper Co. CEM-92
1482-67th Street, Emeryville, California

☐ Send me Clearprint samples, with prices, for the following uses:

_____

Name_____

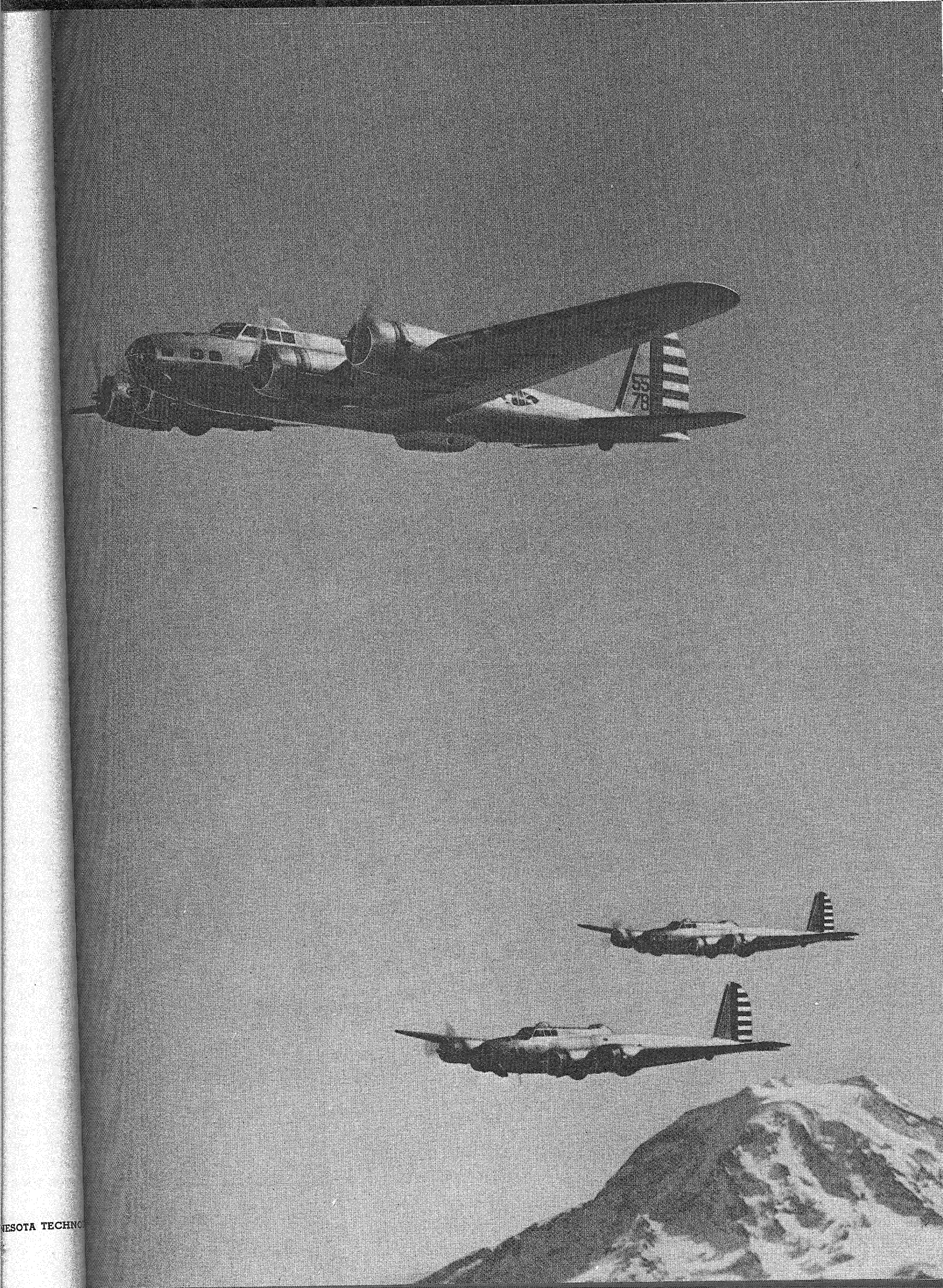
Title_____ Firm_____

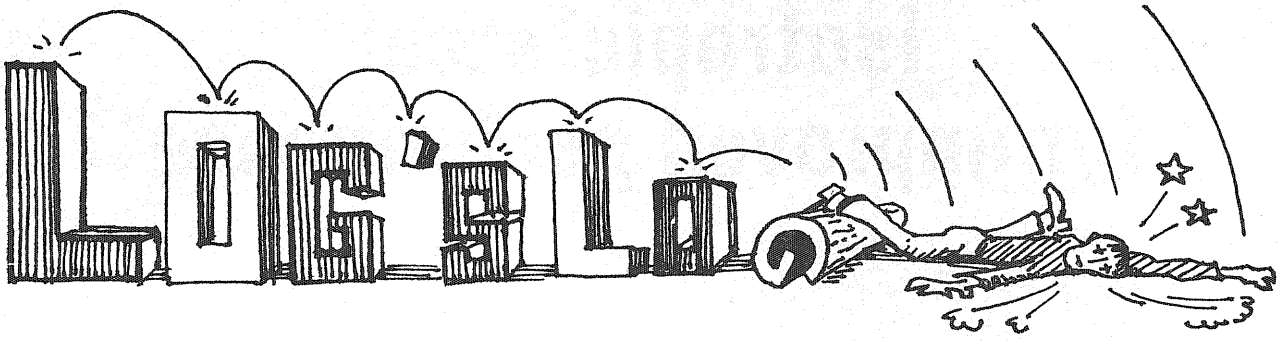
Address_____

City_____ State_____ Zip_____

CLEARPRINT®

"Fade-Out"™ Paper/Technical Paper/Forms
Charts/Graphs/"Pre-Print"™ Paper


55
78



INTRODUCTION: This being the fifth consecutive year of LOG'S LOG the editors thought we should celebrate the joyous occasion with something stimulating to our readers (bless their dirty minds)—a pair of new writers. As Captain America and his side-kick Dum Dum practice sleeping in their padded chairs and "Jo Ann the money-grubber" counts the pennies she's collected from the newly installed tollgate on the Log office door Mike and I slave over the pain in the posterior that Dave, Dan, and Dave, unloaded on us.

A fitting reward must be set aside for our comrades in arms however. For their dedication and perseverence amid the trials and tribulations of the years, they deserve about $50 apiece (dead or alive).

Along with our new editors, the Log is adopting a new policy. The idea is to turn out a better engineer (if it works on mousetraps). The first screw is imbedded in the following lines.

Lush's Corner

In keeping with our policy, yours truly has created this new addition to the Log's Log. The purpose is to improve Friday nights (or any night for that matter). This month's lesson has been devoted to that age old he-man refresher Scotch. Considering sixteen per-cent of all whisky consumed is Scotch, we thought it a fitting tribute to include it as part of this feature.

To our do-it-yourselfers out there, here's the handy dandy how to. First take one large quantity of malted barley (barley that has been allowed to sprout). After mashing and adding a little water, boil it in a peat oven and allow the smoke of the burning peat to filter through it (if you're Irish, the smoke is a no no). Throw the slop into a winesoaked oak cast and wait around for about ten years.

If you don't have ten years to use for waiting around and prefer to let the masters do their thing, your local bottle shop may be of some service to you. Just remember that the professionals aren't as altogether lily white as they seem to be. The favorite fudge is reusing the casts, which leaves the second batch lighter in color. This is corrected by adding a little caramel. Most Scotch is imported in large quantities at relatively high proof to this country where it is watered down and bottled. Sometimes the bottlers mix a bunch of these bulk scotches and call it blended whiskey (they figure one batch will kill the taste of the others).

If you're a natural born mixer there isn't too much fo you to choose from. Ice, water, or soda are the majo choices. If you're willing to try anything once, add little milk to your next Scotch on the rocks.

Relativity

As another special feature of the Log's Log, Bria and I would like to give you a look at parts of our famil trees. (No, *not* that tree!) Who knows, our type o relativity may become more famous than Albert's.

Yours truly, Mike, has many celebrated fore-fathers a both ends of the spectrum. My great-great-great-grea great etc. grand-father is on the $10,000 bill. This is onl hearsay, though, because I have never had more than $ in my possession at any one time. On the other hand one of my great-uncles was hanged in Kansas for horse rustling.

Brian's great-grandfather, Stanislaus Stupidski, stea the show. Stanislaus Stupidski was a World War I flyin ace for the Polish Air Farce. (That's right—Farce). H was recently honored last weekend in Twig, Minnesot for his heroic efforts fighting the Luftwaffe. The emce of the program invited Stan to relate his most harrowin experience as a fighter pilot. Stanislaus Stupidski ap proached the mike and told how he shot down thre German planes over Warsaw.

"There were these three Fokkers who were terrorizin the country-side," he said. "I decided to rid the count of these Krauts. It was a terrible task. I shot down on Fokker as he crossed my nose. The second one I chase for fifteen minutes before I destroyed him. The last Fo ker was the most elusive. It took me about an hour, but finally forced him to crash. That's how I shot down thre Fokkers in one dogfight." The emcee arose and adde "For the benefit of those who don't know, a Fokker w an old WW I German fighter." Stanislaus interrupte "No, no. Those Fokkers were Messerschmidts!!"

Move to the Rear

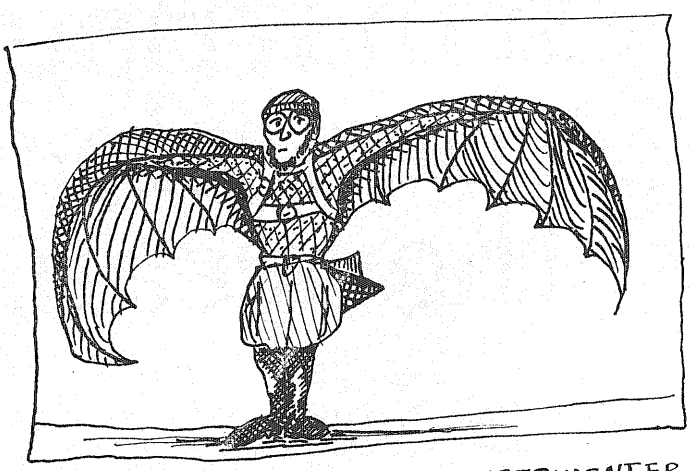
Just think of where our society would be without t eternal bus. No more driver strikes, no more waiting the corner for the 16-A, no more diesel fumes to cov up the delightful fragrance of the Mississippi, and more places to put our "Move to the back of the bu the driver stinks!" stickers. Don't take this wrong, ho ever, we're not out to give our trusty green and whi

steads a hassle. May Rudoff Diesel roll over in his grave! Heavens, without the buses how would we be able to get into our usual good humor on Monday mornings, not to mention ruination of several people's prime purpose for living. What would the mad stop cord pullers have left to relieve their inhibitions on. A cat or dog wouldn't be safe walking his tail on the streets anymore. Let's not forget those sweet little old ladies who plug the seats of a crowded bus with their packages and mumble under their breath, "Stand you hippy, commy, freak!" There is also the pickpockets that specialize in the crowded bus technique. They'd be out of a job and that means we'd have to pay them unemployment compensation. And then there's those fanatics that run to the front of the bus and jam the slot with twenty-nine pennies. Just think what would happen to the vending service coffee machines if they decided to infiltrate our campus.

Let's not forget the helpful drivers. Without them how would we keep control on the population of Volkswagens. They'd be running rampant in the streets if we didn't have our trusty drivers to keep them in check. Yes, we owe a lot to our men in grey. Funny they should choose grey.

THOUGHT FOR THE MONTH: As Gen. Custer said, "The only good Indian is a dead one." Think about it, all you engineers!!

CONCLUSION: In order to answer the age old question, "Why does time always pass?" the A-Z team looked through the crystal at Micky and found his big hand on Minnie's left . . . well, sometimes it's better to let nature take its course. Now, that Spiro has broken into the time racket too, we wondered what he had his little hands on. So, we raise the question to him, "Do you give to the college of your choice?"



ENTHUSIASTIC FLIGHT EXPERIMENTER, GREGO BANSHUCK POSES BRAVELY BEFORE CAMERA PRIOR TO HIS FIRST FLIGHT IN HIS NEWLY DEVELOPED AIR-CRAFT.

"...I'm kind of a marriage counselor for the ocean..."

Vic Taylor is a corrosion specialist for International Nickel at its testing lab in North Carolina.

"...That old ocean doesn't like us sometimes. She rusts boats, eats away metals, destroys coatings... what we're trying to do is come up with alloys she can live with."

Inco's Francis L. LaQue Corrosion Laboratory, at Harbor Island, N.C., is testing materials needed for ocean engineering, desalination plants, water and sewage treatment facilities, bridges, boats, even houses. Testing not just nickel alloys, but 40,000 specimens of materials from many industries. Alloys, fabrics, coatings.

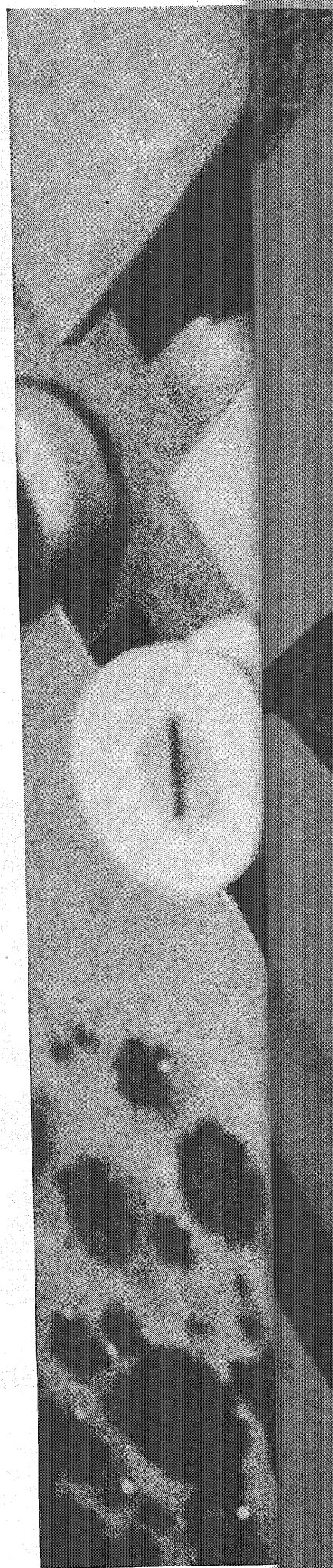
"...Remember how car bumpers used to corrode? Now it's a different story. And we're applying this knowledge to many industries. Making pollution control equipment, for instance, stand up longer than anyone thought possible."

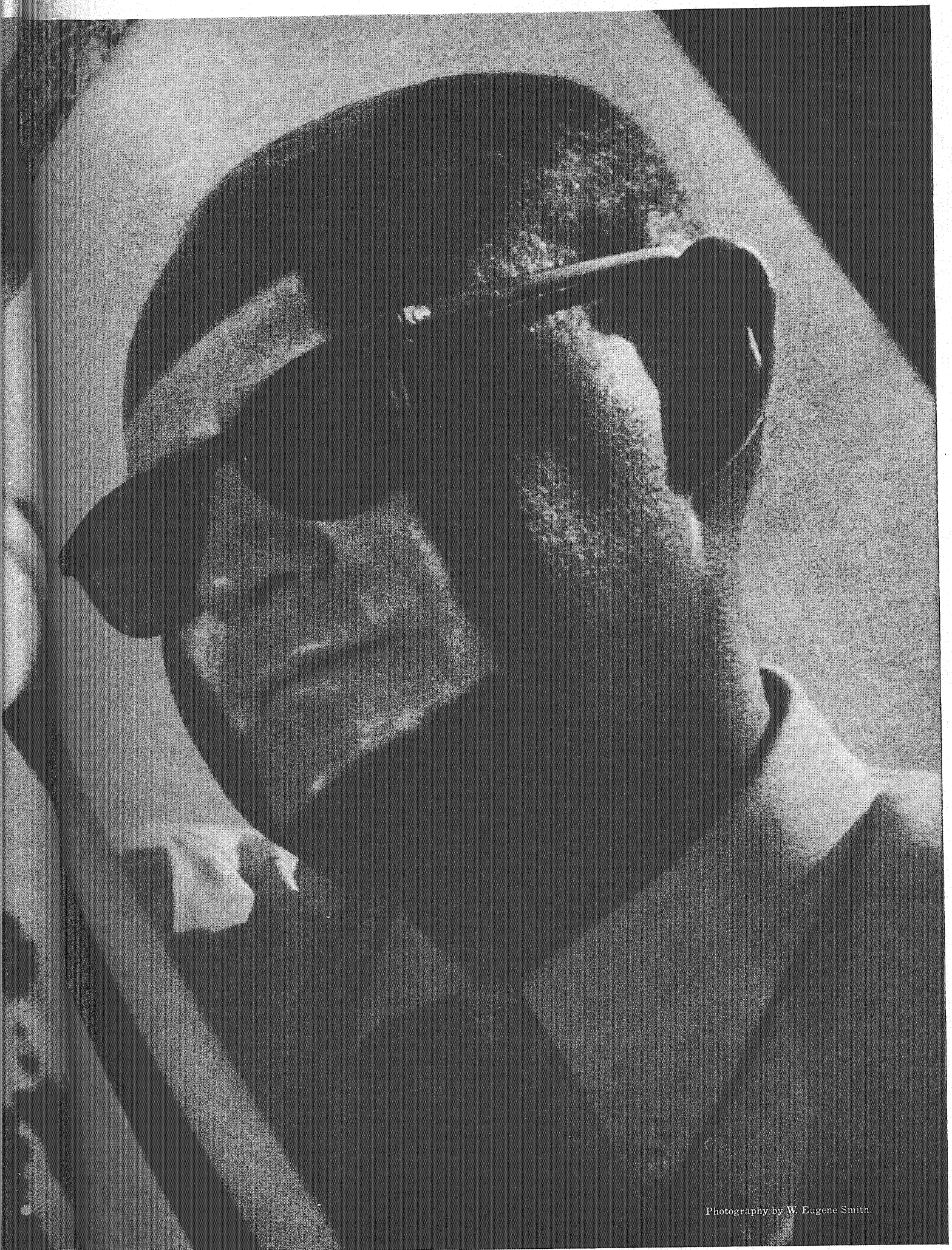
Undreamed of advances are what Inco men are working for. Men who develop alloys, test them, search the world for more nickel. Nickel, the metal that makes other metals stronger, tougher, more corrosion resistant. Nickel, its contribution is quality.

INTERNATIONAL NICKEL

The International Nickel Company, Inc., New York, N.Y.
The International Nickel Company of Canada, Limited, Toronto, Ontario
International Nickel Limited, London, England

Vic holds a nickel-chrome plated automobile bumper which was tested in the corrosive seaside atmosphere.





Photography by W. Eugene Smith.

Chemicals and Food

By Weyland E. Noland

Editor's Note: Professor Noland, outgoing President of Phi Beta Kappa, and organic chemist, gave the following speech at the annual initiation ceremony.

According to the fifth edition of "Webster's Collegiate Dictionary," a *chemical* is defined as a substance obtained by a chemical process, or used for producing a chemical effect, and *chemistry* is the science that treats of the composition of substances, and of the transformations which they undergo. By these definitions foods are quite properly classed as chemicals, which happen to be of biological origin. The dictionary definition of *food* is that it is nutritive material taken into an organism for growth, work, or repair and for maintaining the vital processes. By separating the terms "chemicals" and "food" in my title I have chosen to emphasize the popular conception that chemicals are things which are added by man to food, because what I really want to talk about are food additives, that is chemicals which are added to food to improve, maintain, or disguise its properties in one way or another. A more official definition, that of the National Academy of Sciences-National Research Council, is that "a food additive is a substance or mixture of substances, other than a basic food stuff, which is present in food as a result of any aspect of production, processing, storage, or packaging. The term does not include chance contaminants."[1a] In particular, I should like to point out why food additives are used, and what are some of the possible cautions and hazards associated with their use. The recent controversy surrounding the use of cyclamates as sweetening agents in beverages and foods has served to bring this matter to the forefront. Mr. Ralph Nader, the scourge of Detroit, with his usual sense of what the public is or is likely to become concerned about, has now turned his attention to the field of food additives. His organization, the Center for Study of Responsive Law, has published the mimeographed draft of a book by one of his lawyer associates, James S. Turner, called *The Chemical Feast*, which takes out after the already much-abused Food and Drug Administration on the subject of regulation of food additives.[2]

Food additives are nothing new, as any cook can tell you. Every time you sprinkle salt, pepper, or sugar on your food you are using additives, but these chemicals are so common that they don't even appear in some popular listings of food additives, salt and sugar also being classed as nutrients. The literature on the relation between hypertension (high blood pressure) and high salt intake has been sufficiently convincing to me that I never salt any food at the table. I get all the salt I need, and probably more, from the amounts added during the cooking process. While there are undoubtedly other factors at work as well, my blood pressure, which used to be on the high side of normal, is now lower than it used to be, and is quite normal. Another common additive, table sugar (sucrose), which is also a food, has been implicated in some British studies by Yudkin as the causative agent in atherosclerosis.[3]

Aside from the common additives already mentioned, the estimated U.S. consumption of major food additives in 1969 was 789 million pounds, almost 8/10ths of a billion pounds valued at 343 million dollars.[4] With the increasing emphasis on convenience and ready-to-eat foods, and on mass feeding, the use of food additives is certain to increase. The largest volume item is the emulsifiers or surfactants, with estimated U.S. consumption at 179 million pounds in 1969.[4] These are largely mono and diglyceride esters, used to emulsify water in oil, and the polysorbates used to emulsify oil in water. The bakery industry is a big outlet for emulsifiers for use in shortening which consume 55-60%, but other important uses are cake mixes, peanut butter, ice cream, frozen dessert coffee "creamers," whipped toppings and margarines—the latter of which alone consume 7-8 million pounds per year of mono and diglycerides. I do not foresee serious toxicity problems in the area of emulsifiers.

The next biggest volume item are the acidulants, with an estimated U.S. consumption in 1969 of 145 million pounds, valued at 29.5 million dollars. About half of this is citric acid, a quarter is phosphoric acid, and with lesser amounts of fumaric acid, malic acid, adipic acid, tartaric acid, succinic acid, lactic acid, and others. The acidulants give tartness or acidity to canned fruits, fruit juices, and candy. They alter the pH of jams and jellies to prevent crystallization, and are used in pickling foods and for carbonated soft drinks. I do not foresee serious toxicity problems in this area.

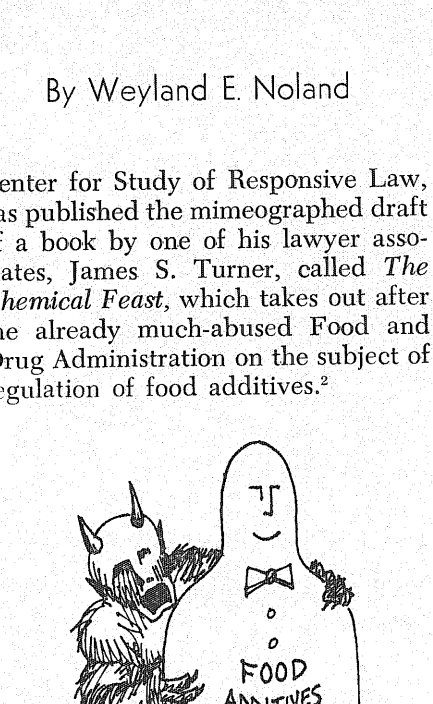
The third largest volume item is the stabilizers and thickeners, with an estimated U.S. consumption in 1969 of 124 million pounds, valued at 50 million dollars.[4] These include agar, gum arabic, sodium alginate, carboxymethylcellulose, and guar gum

Chemicals and Food

By Weyland E. Noland

Editor's Note: Professor Noland, outgoing President of Phi Beta Kappa, and organic chemist, gave the following speech at the annual initiation ceremony.

According to the fifth edition of "Webster's Collegiate Dictionary," a *chemical* is defined as a substance obtained by a chemical process, or used for producing a chemical effect, and *chemistry* is the science that treats of the composition of substances, and of the transformations which they undergo. By these definitions foods are quite properly classed as chemicals, which happen to be of biological origin. The dictionary definition of *food* is that it is nutritive material taken into an organism for growth, work, or repair and for maintaining the vital processes. By separating the terms "chemicals" and "food" in my title I have chosen to emphasize the popular conception that chemicals are things which are added by man to food, because what I really want to talk about are food additives, that is chemicals which are added to food to improve, maintain, or disguise its properties in one way or another. A more official definition, that of the National Academy of Sciences-National Research Council, is that "a food additive is a substance or mixture of substances, other than a basic food stuff, which is present in food as a result of any aspect of production, processing, storage, or packaging. The term does not include chance contaminants."[1a] In particular, I should like to point out why food additives are used, and what are some of the possible cautions and hazards associated with their use. The recent controversy surrounding the use of cyclamates as sweetening agents in beverages and foods has served to bring this matter to the forefront. Mr. Ralph Nader, the scourge of Detroit, with his usual sense of what the public is or is likely to become concerned about, has now turned his attention to the field of food additives. His organization, the Center for Study of Responsive Law, has published the mimeographed draft of a book by one of his lawyer associates, James S. Turner, called *The Chemical Feast,* which takes out after the already much-abused Food and Drug Administration on the subject of regulation of food additives.[2]



Food additives are nothing new, as any cook can tell you. Every time you sprinkle salt, pepper, or sugar on your food you are using additives, but these chemicals are so common that they don't even appear in some popular listings of food additives, salt and sugar also being classed as nutrients. The literature on the relation between hypertension (high blood pressure) and high salt intake has been sufficiently convincing to me that I never salt any food at the table. I get all the salt I need, and probably more, from the amounts added during the cooking process. While there are undoubtedly other factors at work as well, my blood pressure, which used to be on the high side of normal, is now lower than it used to be, and is quite normal. Another common additive, table sugar (sucrose), which is also a food, has been implicated in some British studies by Yudkin as the causative agent in atherosclerosis.[3]

Aside from the common additives already mentioned, the estimated U. S. consumption of major food additives in 1969 was 789 million pounds, almost 8/10ths of a billion pounds, valued at 343 million dollars.[4] With the increasing emphasis on convenience and ready-to-eat foods, and on mass feeding, the use of food additives is certain to increase. The largest volume item is the emulsifiers or surfactants, with estimated U. S. consumption at 179 million pounds in 1969.[4] These are largely mono and diglyceride esters, used to emulsify water in oil, and the polysorbates, used to emulsify oil in water. The bakery industry is a big outlet for emulsifiers for use in shortenings, which consume 55-60%, but other important uses are cake mixes, peanut butter, ice cream, frozen desserts, coffee "creamers," whipped toppings, and margarines—the latter of which alone consume 7-8 million pounds per year of mono and diglycerides. I do not foresee serious toxicity problems in the area of emulsifiers.

The next biggest volume item are the acidulants, with an estimated U. S. consumption in 1969 of 145 million pounds, valued at 29.5 million dollars. About half of this is citric acid, a quarter is phosphoric acid, and with lesser amounts of fumaric acid, malic acid, adipic acid, tartaric acid, succinic acid, lactic acid, and others. The acidulants give tartness or acidity to canned fruits, fruit juices, and candies. They alter the pH of jams and jellies to prevent crystallization, and are used in pickling foods and for carbonating soft drinks. I do not foresee serious toxicity problems in this area.

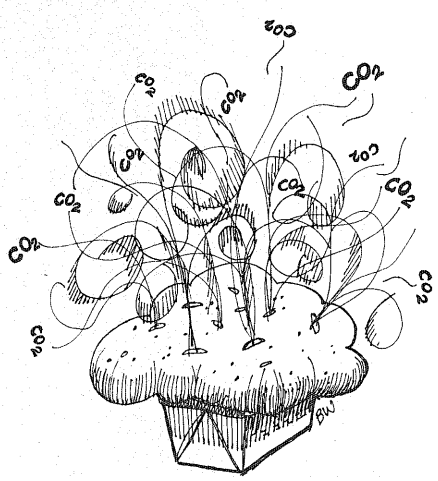
The third largest volume item are the stabilizers and thickeners, with an estimated U. S. consumption in 1969 of 124 million pounds, valued at 95 million dollars.[4] These include agar, gum arabic, sodium alginate, carboxymethylcellulose, and guar gum a

stabilizing agents, while thickeners, which often function as moisture retainers, include firming agents, anticaking compounds, and moisture retainers such as calcium chloride, calcium silicate, glycerol, gelatin, magnesium silicate, and propylene glycol. Again, I do not foresee serious toxicity problems in this area.

The fourth largest volume food additive area is the flavor agents and enhancers, with an estimated U. S. consumption in 1969 of 87 million pounds, valued at 75.3 million dollars.[4] These include fragrant, volatile compounds, including esters such as ethyl acetate and butyrate, and alcohols, aldehydes, ketones, and lactones. Other flavor agents and enhancers include vanillin and monosodium glutamate. Monosodium glutamate intensifies and enhances flavor but, in the quantities normally used, does not add any flavor of its own, though in high concentrations it has a sweet-saline taste.[1b] This is the best known and most widely used flavor enhancer, U. S. production in 1966 being 46 million pounds.[1b] It is nothing more than the sodium salt of one of the important dietary amino acids, glutamic acid. Consequently, it is surprising that there has been so much rumpus about the use of monosodium glutamate, especially in baby foods, however ill-substantiated the objections may be. If there is any problem here at all, except as a useful political football, then it probably lies in the generalization that "you can have too much of a good thing." If toxicity problems involving flavor agents and enhancers are to be discovered in the future, there is some consolation in the fact that the concentrations which have been used to provide the desired effects are small.

The fifth largest volume food additive classification is the leavening agents, with an estimated U. S. consumption in 1969 of 75 million pounds, but with a relatively low value of only 4.8 million dollars.[4] These are relatively cheap acidic compounds, such as mono- and dicalcium phosphates, sodium acid pyrophosphates, and potassium acid tartrate. They are used as acidulants in baking powders to cause release of carbon dioxide gas from soda in the mixture during the baking process.

The six largest volume food additive area is the preservatives and antioxidants, with an estimated U.S. consumption in 1969 of 60.5 million pounds, valued at 33.5 million dollars.[4] Such additives are necessary to prolong shelf life and prevent spoilage of foods by inhibiting growth of mold, bacteria, and fungi and retarding the attack of atmospheric oxygen, which causes rancidity in fats and oils. Important preservatives include sodium nitrite, often accompanied by sodium nitrate, which are widely used as preservatives in canned meats, especially pork products such as luncheon meats and vienna sausages, as well as uncanned sausages and weiners, and other cured and smoked meats and fish. Sodium benzoate is widely used as a preservative in acidic foods and beverages, particularly soft drinks, since the acid, benzoic acid, which is liberated under acidic conditions is an efficient, economical antimicrobial agent. Calcium and sodium propionates, which are quite non-toxic, are similarly used widely in bakery goods, and in bread the calcium added in the form of calcium propionate provides an added nutrient. Butylated hydroxytoluenes (BHT), butylated hydroxyanisole (BHA), and propyl gallate are members of the class of phenolic compounds, some other members of which, such as phenol, are toxic. They function as free radical scavengers, called inhibitors, which react with and destroy free radicals before these radicals can initiate the chain reaction of fats and oils, especially unsaturated ones, with atmospheric oxygen, which leads to rancidity. With the increasing emphasis on



the dietary desirability of unsaturated fats and oils over saturated fats, the need for effective antioxidants assumes even greater importance than ever. The very promising dehydrated fish meal industry, which should provide a very economical source of dietry protein to feed the population explosion, probably couldn't get off the ground (or out of the sea) without antioxidant food additives.

Antimicrobial agents, by the nature of their function, are toxic to some forms of life. It would seem reasonable, therefore, that the probability of their being toxic to human life, as well, should be greater than with other kinds of food additives. I am particularly concerned about the use of sodium or potassium nitrite as food additives. Besides its more justifiable use as a moderately effective antimicrobial agent, nitrite is used in curing mixtures for meats to develop and fix the color, since under acidic or mildly reducing conditions it decomposes to nitric oxide, NO, which then reacts with heme pigments in the muscle tissue to form nitrosomyoglobin.[1c] I think people would be better off if they got used to the pale color of old meat, rather than insisted on it being red where the redness comes from treatment with nitrite. The acute oral toxicity of sodium nitrite is not high, since the oral minimum lethal dose in rats and dogs is 330 milligrams per kilogram, and the amount of nitrite required to form methemoglobin in the living organism (which would impair the oxygen-carrying capacity of the blood) is relatively large.[1c] But there are other potential hazards associated with the use of sodium nitrite as a food additive. In acid medium, which would be present as soon as nitrite hits the stomach, if not before, the nitrite would be converted to the thermally unstable and very reactive nitrous acid, which is a very effective nitrosating agent for amino compounds. Some nitrosated secondary aliphatic amines, such as N-nitrosodimethylamine, are potent carcinogens (and possibly mutagens as well), being known to cause tumors of the liver, kidney, and other tissues in rats, mice, and hamsters.[5] Liver tumors have also been induced by the same agents in somewhat less sensitive larger species such as rabbits, dogs, guinea pigs, and even closer to home, monkeys.[5] What would happen if any secondary aliphatic amines, such as may be present in fish products—in some of which nitrite is also used as a preservative, were present in the stomach at the same time as nitrite is ingested? At the least, it would seem that nitrous acid in the stomach would be con-

Goodbye, lake.

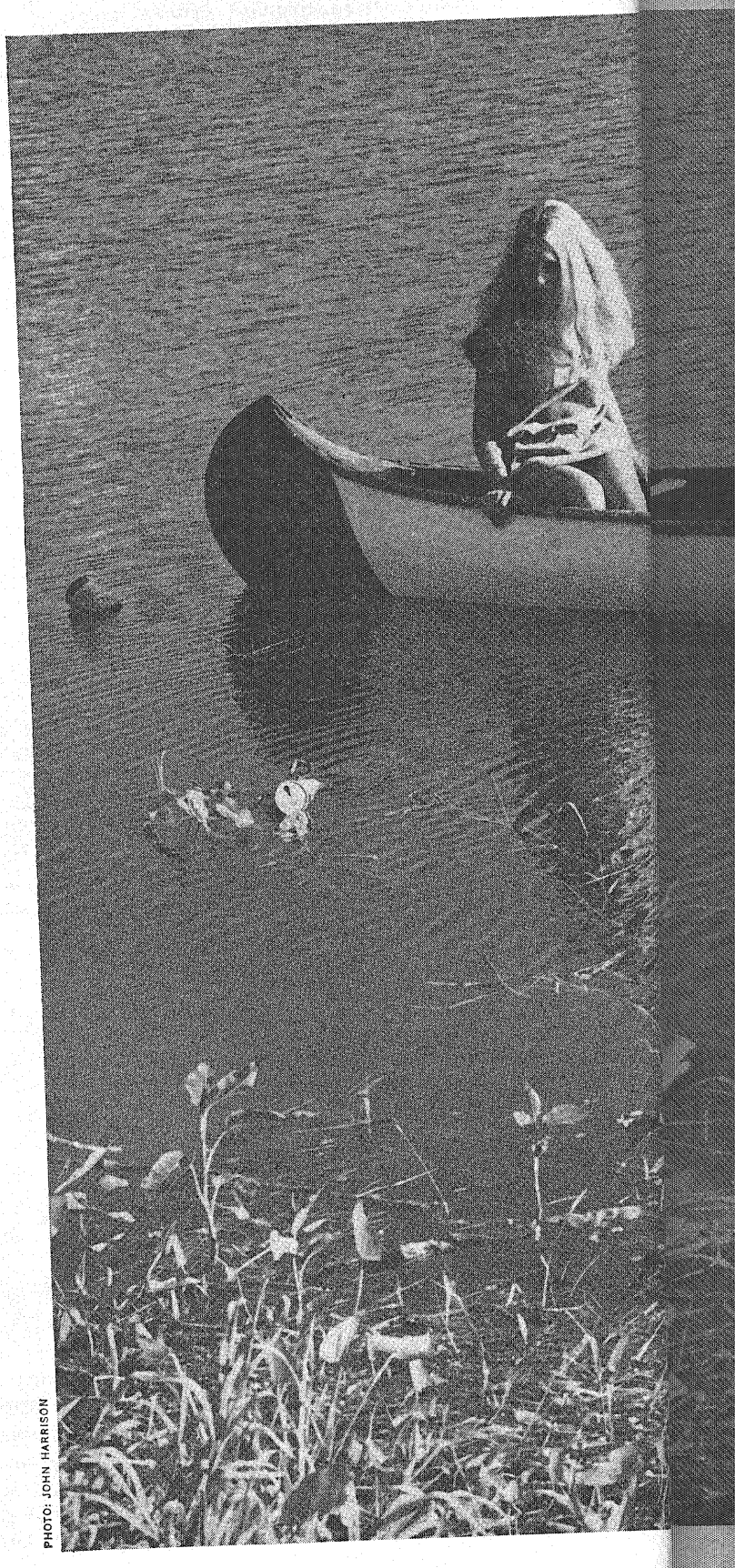
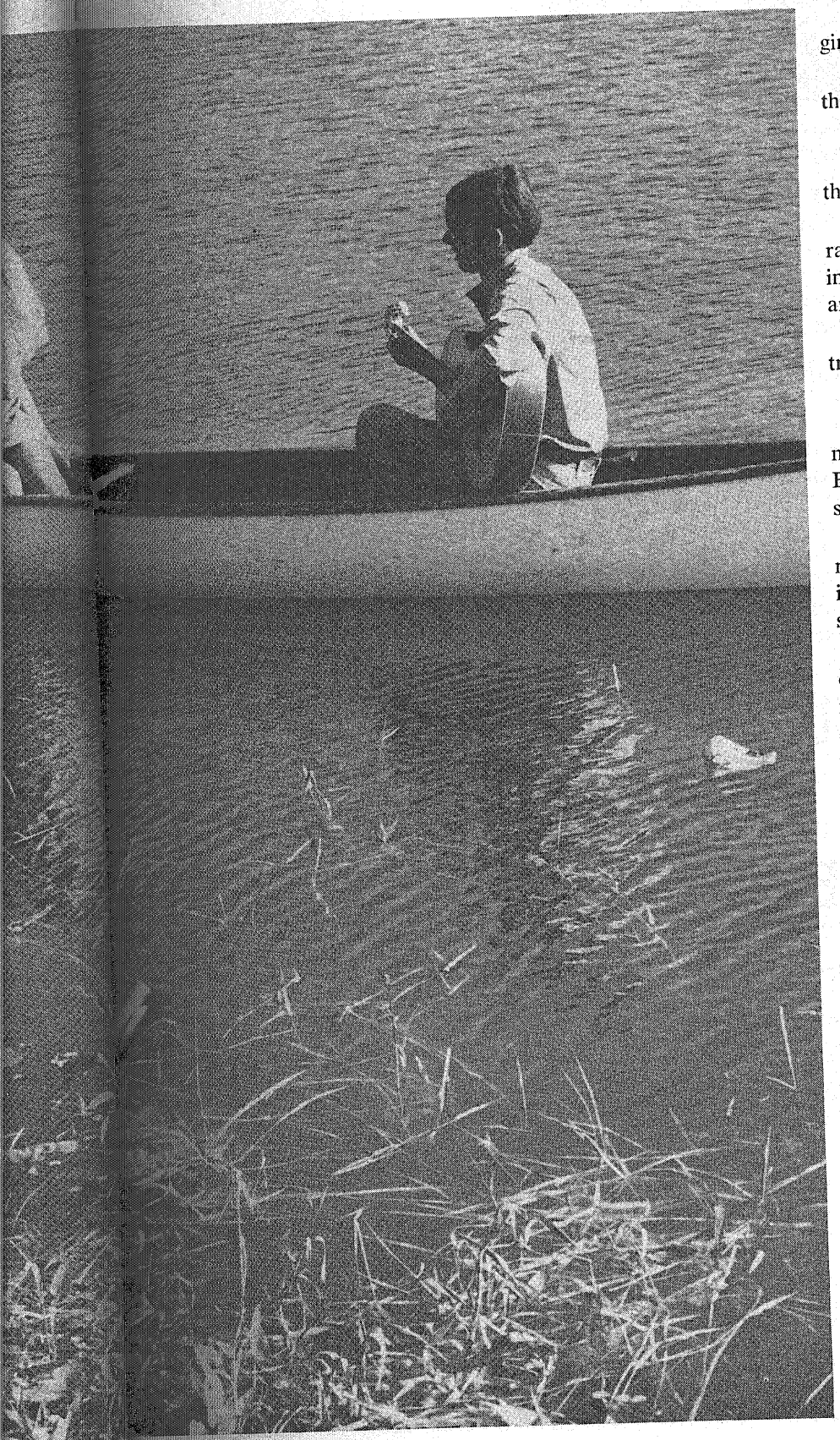


PHOTO: JOHN HARRISON



Remember that afternoon you took your girl and guitar down to the lake?

The water was filled with garbage. And the smell matched the scene.

Pollution.

It blows the image. The ecology. Everything.

FMC is a billion and a half dollar corporation, one of the nation's top 100. We're in chemicals, fibers, metalworking, mining, and a lot of related activities.

No surprise then that we're in waste treatment and water pollution control, too.

For ourselves. For everyone.

FMC builds sewage treatment equipment for the biggest cities, and the smallest. Every community doesn't use a treatment system, but we wish they would.

FMC engineers also solve waste treatment problems for industrial plants. Some industries are doing a good job. But a lot still needs to be done.

Our environmental laboratory and our chemical research center are searching for more effective materials and working on new treatment concepts. We have some of the best systems available.

By pooling talents in our diversified company, we're giving rivers and lakes a new lease on life.

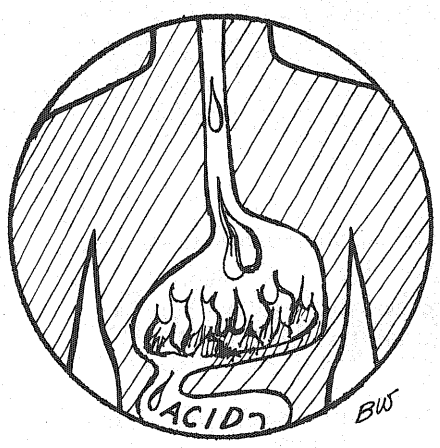
If you'd like to do something about things that need doing, write for our brochure, "Careers with FMC." Or pick up a copy from your placement office. FMC Corporation, Box 760, San Jose, California 95106.

We're an equal opportunity employer.

fmc CORPORATION ®

FMC CORPORATION

Putting ideas to work to make water beautiful

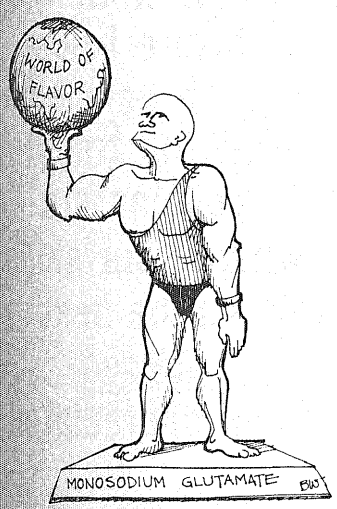


sumed by diazotization of ammonia or primary amino groups of amino acids, thus reducing, to the extent that it is stoichiometrically present, the nutritive value of protein foods ingested at the same time. Another potential hazard with nitrous acid is that it is a potent mutagen in bacteria, viruses, molds, and other organisms.[6] Not surprisingly, it attacks the primary amino groups of nucleotides in DNA, the material of which genes are made, replacing the nitrogen with an oxygen atom, thus potentially garbling the genetic message in the gene at that point.[6] Conceivably, this could cause mutations of stomach cells and lead to cancer of the stomach. Dr. Ernest Freese, Chief of the Laboratory of Molecular Biology at the National Institute of Neurological Diseases and Stroke, believes that the mutagenic effects of nitrous acid in lower organisms are sufficiently ominous to suggest strongly that the use of sodium nitrite in foods should be severely curtailed, if not completely banned.[6] I agree with him 100%; as a result, my favorite luncheon snack, vienna sausage, all of the brands of which I have seen contain sodium nitrite as a preservative, has been replaced with canned tuna, the label of which does not indicate the presence of nitrite.

What was, at least, the seventh largest volume food additive area is the synthetic sweeteners, with an estimated U. S. consumption in 1969 of 11.8 million pounds, valued at 11.3 million dollars.[4] This is where the action is right now; in the preceding discussion I have suggested one of the places where I think the action may be in the future. Cyclamates, which are nothing more than the sodium or calcium salts of the sulfamide of cyclohexylamine, seem to be on the way out. Massive doses, far greater than would be ingested from use as a food additive, have been found to produce bladder tumors in rats, the same organ in which the carcinogenic aromatic amines seem to concentrate their action. Not surprisingly, saccharin, the older and supposedly safer sugar substitute, is now in for an intensive reinvestigation. Personally, I don't see why anyone wants to take any chance at all with such additives, which, in

contrast to sugar, have zero food value. Is satisfaction of the taste buds all that important? Can't they be conditioned to get along without sweets?

The miscellaneous category of food additives, which comprises vitamins, colors, trace minerals, and amino acids used as dietary supplements, had an estimated U. S. consumption in 1969 of 106.5 million pounds, valued at 44.3 million dollars.[4] In volume, this category would rank between the third category (stabilizers and thickeners) and the fourth category (flavor agents and enhancers) which I have already discussed. Here, I would suggest that the area which deserves the most further investigation would be colors, which, in general, have no food value and are pleasing only to the eye and not to the stomach. Why take chances here? After all, the azo dye, butter yellow (4-dimethylaminoazobenzene), which many years ago was used to color butter and margarine, was found to cause liver cancer when fed to rats on a vitamin-deficient rice diet.[5] Needless to say, it is not used as a food additive any more.



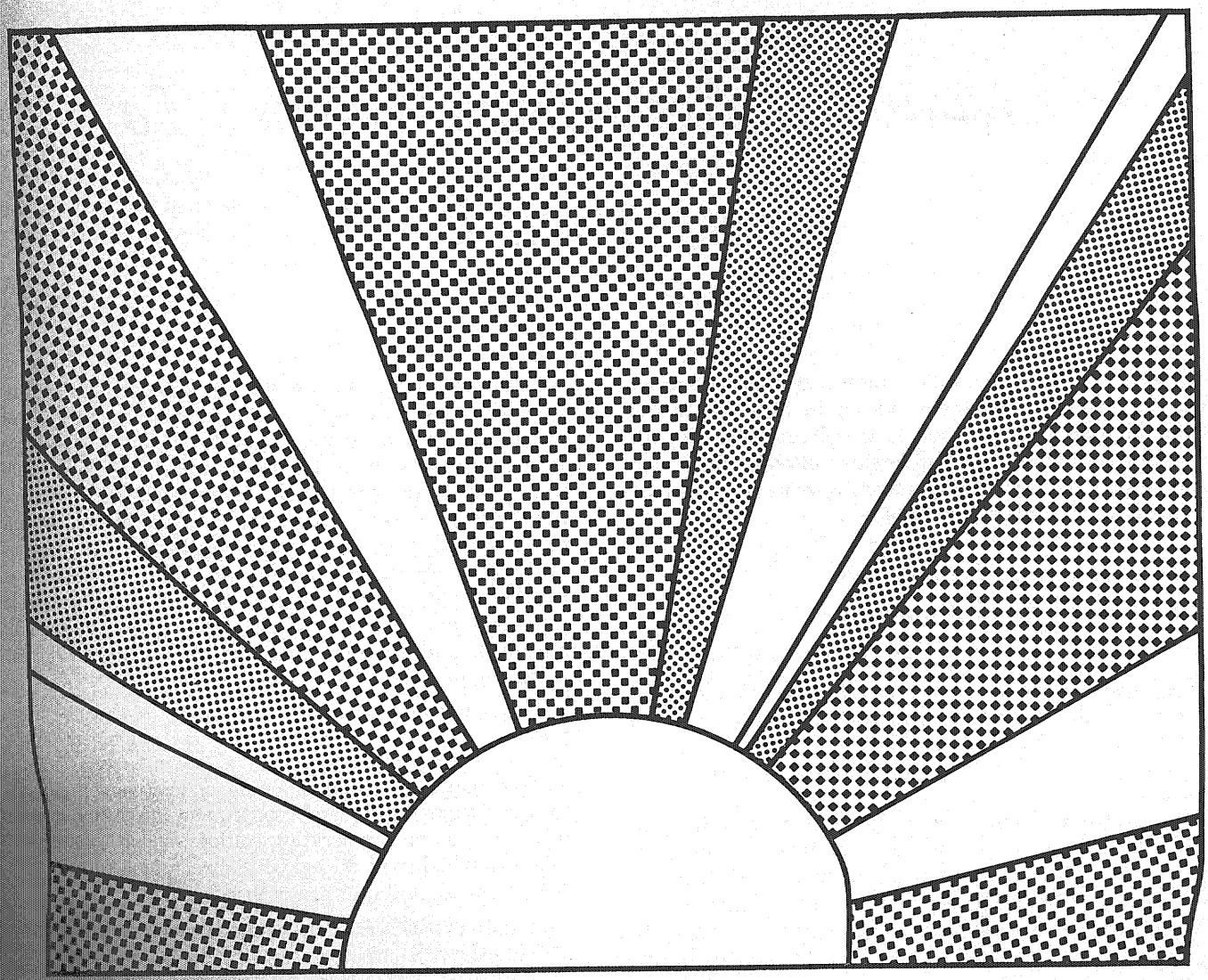
Another compound, which is not generally considered as a food additive, but which is widely consumed by man, and about which there should be plenty of concern and is plenty of controversy, is caffeine. Caffeine is the stimulant ingredient in coffee and cola soft drinks, and one of those in tea, and is present as the stimulant ingredient, along with aspirin, in the APC or similar types of headache remedies and pain relievers such as Empirin Compound, Anacin, Excedrin, Cope, Vanquish, and Stanback. It is also present, as a stimulant in Bromo-Seltzer, Neo-Synephrine cold tablets, and No-Doz.[6] Caffeine is a purine, and

is, therefore, structurally related to two of the four different nucleotide bases of DNA, specifically adenine and quanine. Caffeine has been shown to be mutagenic in bacteria and fungi, and to cause chromosome damage in onion root tips, fruit flies, cultured human cancer cells, and in human white blood cells.[6] These observations caused Dr. Wolfgram Ostertag, the man who made the observations with the human cells, to conclude with his co-workers in 1968, "There is—a strong likelihood that caffeine may prove to be one of the most dangerous mutagens in man. Further experiments using caffeine in other mammals are now in progress—and might lead to a more certain conclusion (as to) whether caffeine is really mutagenic in man."[6] Dr. Maynard B. Chenoweth, a pharmacologist at the Dow Chemical Co., has declared that caffeine is "the number one candidate for study as a potentially mutagenic chemical in man."[6] Since caffeine is believed to permeate every cell of the human body, it can presumably permeate not only the somatic cells but also the germ cells in the gonads.[6] If it causes mutations in the testes and ovaries this could cause genetic damage which would be passed on to future generations. In this respect, the mutageneci effect of caffeine is potentially more dangerous than that of nitrous acid, since nitrous acid is so reactive that it presumably does not get beyond the stomach or intestinal tract in its original form. On the optimistic side, a study by Dr. Mary F. Lyon and coworkers at the Atomic Energy Establishment in Harwell, England, with more than 64,000 offspring of male or female mice treated with caffeine at a daily dosage of 250 milligrams per kilogram of body weight, a much greater dosage than normally would be taken by man, gave no observable evidence of an increase in the mutation rate over that of a control group.[6] Dr. Avram Goldstein, a Professor of Pharmacology at Stanford University, has stated, "It seems probable that caffeine is not a significant mutagen in man."[6] Even if caffeine is not a mutagen in man, however, it still may be a genetic threat, as there is evidence that it inhibits repair of DNA already damaged by ultraviolet or X-ray radiation in bacteria, cultured mouse cells, and cultured human embryonic lung cells.[6] In another study with hundreds of mice, no evidence was found that caffeine interferes with repair of DNA damaged by X-rays or various alkylating agents.[6] My own personal conclusion from all of this controversy is that I would not hesitate to take caffeine to keep from falling asleep at the wheel of a car (which might easily cause something akin to acute toxicity) or on an important assignment, but, until the smoke of controversy clears away, I would advise against caffeine-containing beverages on a day-in-and-day-out basis until the child-bearing age is passed.

There is probably no such thing as a totally safe food additive when one disregards all restrictions on the amounts which can be used in experimental toxicity tests. Probably, under these circumstances, somebody will eventually find something wrong with everything. Rest assured, a lot of tests haven't been tried yet. In my judgement, what is needed in the regulation of food additives is not a set of arbitrary standards, but rather a carefully considered judgement in the case of each compound as to whether the benefits to be derived substantially outweigh the risks known to be present, as well as those suspected of being present based on the best evidence available at the time. Obviously, this system of regulation, like any other, would need to be continuously updated as new data become available.

References

1. T. E. Furia, Ed., "Handbook of Food Additives", The Chemical Rubber Co., Cleveland, Ohio, 1968 (a) pp. 495-496; (c) pp. 172-176.
2. "Mr. Ralph Nader and Pure Food", *Nature*, 226, 205-206 (1970).
3. (a) J. Yudkin, *Lancet*, II, 4-5 (1964); *Chem. Abstr.*, 61, 11137f (1964); (b) J. Yudkin, *Lancet*, II, 6-8 (1964); *Chem. Abstr.*, 61, 11137f (1964); (c) K. Osancova and S. Hejda, *Cesk. Gastroenterol. Vyziva Sb. Pathofysiol. Traveni Vyzivy*, 22, (1), 24-30 (1968); *Chem. Abstr.*, 68, 103032v (1968).
4. "New Trouble for a Tasty Market", *Chemical Week*, April 8, 1970, pp. 9-12.
5. J. H. Weisburger and E. K. Weisburger, "Chemicals as Causes of Cancer", *Chem. Eng. News*, Feb. 7, 1966, pp. 124-142.
6. H. J. Sanders, "Chemical Mutagens, An Ezpanding Roster of Suspects", *Chem. Eng. News*, June 2, 1969, pp. 54-68.



Guaranteeing clay pipe is like guaranteeing the sunrise.

Our 100 year guarantee* on clay pipe is almost unnecessary. Because clay pipe's durability is as certain as the rising sun.

Aren't we overstating our case a little?

Not at all. Clay is one of those rare substances that nature made virtually incapable of being corroded or chemically broken down.

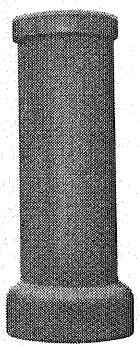
Clay is formed after sun and rain and sleet and snow have beaten away at the earth for thousands of years. When the earth's crust can't be broken down any further, all that's left is a layer of virtually indestructible material. Clay.

Of course, nature doesn't work cheaply. So clay pipe costs a little more than pipe made of cement bonded materials or synthetic plastics.

But what a difference in performance. While you can expect other pipe to last about 5 or 10 years, clay pipe has continued serving in wastewater systems all over the country for generations without any kind of breakdown.

That's why makers of other kinds of pipe seldom guarantee their product for any specific length of time, while we guarantee clay pipe for 100 years and know it's an understatement.

If you want to make sure the pipe in your wastewater system lasts, make sure it's clay. The toughest pipe material under the sun.



W.S. DICKEY *Clay Manufacturing Company*

Kansas City, Missouri; St. Louis, Missouri; Lehigh, Iowa; San Antonio, Texas; Birmingham, Alabama; Meridian, Mississippi; Texarkana, Texas-Arkansas

*Dickey Clay will supply—free of charge—replacements for any clay pipe which has been damaged, destroyed or impaired in service for a period of 100 years from contract date, if damage has been caused by corrosion or other chemical decomposition from acids, alkalis, sewage or industrial wastes (except Hydrofluoric Acid) or damage by rats or other rodents whether pipe is used for industrial, residential or general drainage purposes. Damage from improper handling, placement or trench loading is not covered.

*Everything You Always Wanted To Know About I. T.**

EDITOR'S NOTE: The following is a brief introduction to a few of the departments found in the Institute of Technology and can be used to supplement the department descriptions of the University bulletin. Each segment was written by its respective department chairman. We thank them for their cooperation.

What is Electrical Engineering at the University of Minnesota?

by B. V. Haxby & W. T. Peria

Electrical engineering—the application of electrical energy and the electrical properties of matter for the benefit, amusement, and confusion of man. That's all well and good, but what, really, does an electrical engineer do.

The electrical engineering curriculum is described in the IT bulletin in terms of four options—Circuits and Electronics, Computer Science, Materials and Devices, and Systems—in order to illustrate a useful technical division of the profession. Without any implication that a student must complete a particular option to prepare himself for work in a corresponding area, it is still convenient to use this division in describing typical engineering assignments.

"Circuits and Electronics" is intended to encompass the broad area of analysis and design that is common to most product areas but is perhaps typified by assignments in instrumentation or in a laboratory for the test of components or equipment. As a member of a design team in medical instrumentation, for example, the electrical engineer would interact with medical specialists and perhaps a mechanical engineer, among others, to design apparatus for medical diagnosis, measurement, or treatment. In this and other areas of instrumentation, sensors and transducers to detect the quantity to be measured and to convert it to an electrical signal may well be critical components.

Computer science involves not only computer design but also programming, digital techniques, and applications and accordingly is a universal rather than a one-industry division of electrical engineering. A new engineer in computer design might be responsible, for example, for control circuits for peripheral equipment such as a tape unit for a computer system. An interest in computer software might lead to applications programming for a device or equipment manufacturer where the engineer could write diagnostic programs for the testing of digital circuits or systems.

Graduates interested in devices or materials applications are especially likely to find themselves members of an interdisciplinary team which also includes competence in such areas as chemistry and physical metallurgy. Failure analysis of integrated circuit chips to determine necessary process modifications is a typical task. Design of integrated circuits or transistors for new applications or to increase their reliability or speed of response is another example. Again, design of a recording head for a tape machine involves knowledge of the mechanical, chemical, and thermal compatibility of many different materials in order to assure reliability of function.

The operations of a power company represent an important example of a "system". Typical assignments available to graduate engineers in a power system include among many, a) sytem planning or long-range study of future system loads and consequent needs for transmission lines and generating stations, and b) protective relaying which will ditinguish between fault currents on a line and acceptable heavy load currents.

Graduates interested in communications might become involved with circuit design for digital or analog communication equipment or with the statistical analysis and computer processing of the quantities of data that build up in such cases as mineral exploration or satellite weather monitors.

An example of an assignment in control systems would be instrumentation for control of a manufacturing process such as food packaging. After measurements of appropriate process variables, the engineer may then convert them into a form appropriate for digital input, weighing the accuracy of measurement, vulnerability to noise, necessary frequency of measurement, etc. He will use these to evaluate the efficiency of the control strategy programmed for a digital computer.

It must be obvious that the few examples above leave great areas unrepresented, but the hope is that the selection has indicated something of the breadth of electrical engineering. Faculty advisors should be able to expand this outline with further examples.

One ingredient is common to all engineering assignments—the problems are new, and no one is fully prepared to solve them without thought and ingenuity. An engineer's education cannot stop with his last degree, and the boundaries between disciplines become steadily fuzzier.

It is difficult to infer from these examples of typical assignments for the inexperienced engineer the new ways in which electrical engineering will interact with our society in the future. Such areas as educational tech-

**But Were Afraid To Ask*

nology and transportation systems seem especially suited for the electrical engineer's contributions in terms of both apparatus and analytical techniques. In fact, among the department's current research activities are transportation system planning, techniques for analysis of large-scale systems, noise pollution and abatement, and urban planning, quite aside from the broad range of purely technical subjects under investigation.

What are Aerospace Engineering and Mechanics at Minnesota?

by A. A. Blatherwick

The department of Aerospace Engineering and Mechanics is unique among institutions in the upper midwest. It is the only department offering a curriculum leading to the degree, Bachelor of Aerospace Engineering and Mechanics. The curriculum is quite flexible, enabling the student to plan a program that is especially suited to his individual interests. In developing programs, most students are encouraged to choose one of several available options. By selecting technical electives from among a group of courses recommended for a given option, the student prepares himself to become a specialist in that particular area. The options currently available are: Aerodynamics and Fluid Mechanics, Design and Performance of Aerospace Vehicles, Structures and Solid Mechanics, Dynamical Systems and Control, and Propulsion and Thermal Science. In addition to these options, it is possible for a student to plan other less common programs such as bio-mechanics or material engineering.

While this department is normally regarded as Aerospace Engineering, it is worth noting that Engineering Mechanics is included in its offerings. All the introductory courses in solid mechanics, taken by students in the Institute of Technology, are given by this department. In addition, intermediate and advanced courses in fluid and solid mechanics are offered. A student who elects to major in Engineering Mechanics may prepare himself to work in any large engineering company.

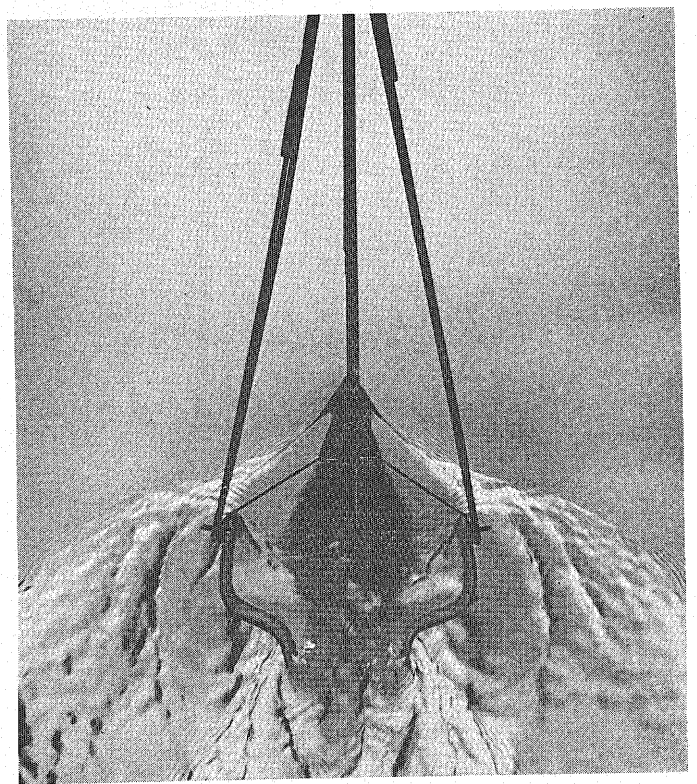
On the basis of undergraduate enrollment the department is the third largest in the Institute of Technology. For several years the enrollment has remained fairly constant at about 300 students. The average graduating class is 50 to 60, but in 1969 the total number of graduates was 83, the largest class in recent years. There are 52 graduate students in the department, 31 of whom are working toward the Ph.D. degree. Included in the graduate enrollment are five students who are beginning a new Master of Engineering program. There are 19 full time faculty members, and 13 additional full-time-equivalent graduate Teaching Associates and Instructors.

In addition to the formal curriculum, the educational program of the department is augmented by a strong research program. Although the main effort of this program is the training of graduate students, there is considerable opportunity for undergraduates to gain experience. Several projects employ undergraduate assistants part time during the school year and full time in the summer. These students gain valuable experience and at the same time receive sufficient remuneration to make a significant contribution toward financing their educational expenses.

One of the largest of these research programs is in the area of Aerodynamic Deceleration under the direction of Professor Helmut G. Heinrich. This work is under the sponsorship of the U. S. Air Force, the U. S. Army, the U. S. Navy, and Industry. Professor Heinrich is an internationally recognized authority in this field. He has published extensively, and he holds a number of patents on subsonic and supersonic parachutes and devices for controlling them.

This program has been a very active one in this department for several years. Literally hundreds of students have been employed in the laboratories on these projects, and the experience they have gained has been of significant benefit in their careers. Currently, there are 2 graduates and 10 undergraduate students working on various projects in the program.

One of these projects concerns the correlation of all phenomena occuring when a parachute inflates. There are problems of continuity between air in-and out flow, dynamic effects due to rapid changes of momentum, the kinematics of the system and finally the material stresses

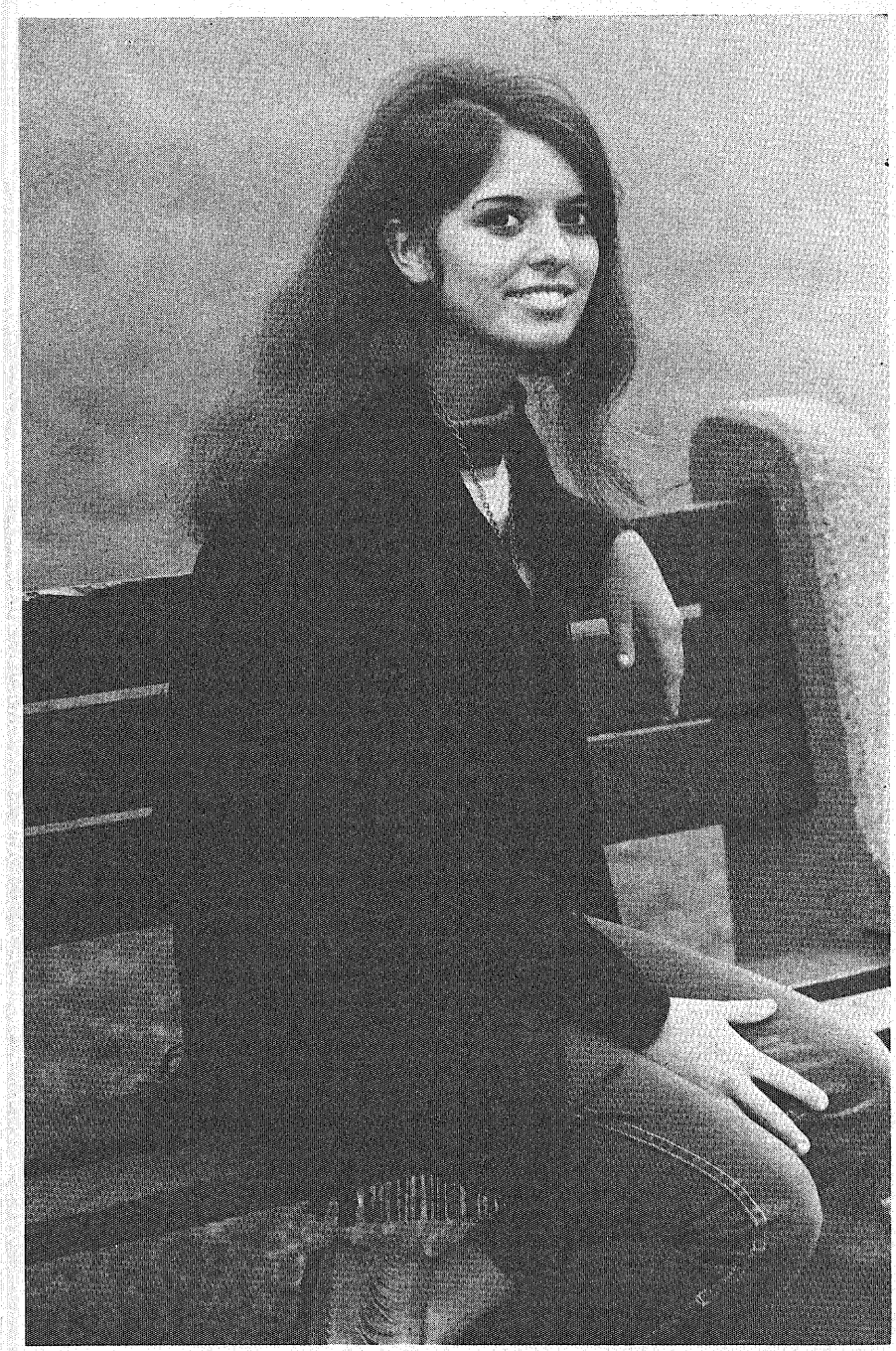


Flow Pattern around a two-dimensional model of the supersonic guide-surface parachute using water anology.

caused by the pressure difference between the two sides of the parachute canopy. The study of this area involves analytical approaches supplemented by laboratory tests and a strong engineering effort to combine everything into a workable theory.

Another project has to do with the flow properties surrounding a body in supersonic flow and the aerodynamic

Gail Bull



MISS OCTOBER

Photos by DON NEAL

Our Miss October is a sophomore in CLA and presently without a major. A real sports enthusiast, Gail enjoys both snow and water skiing. We are sure that you will consider her a charming addition to our 50th anniversary issue.

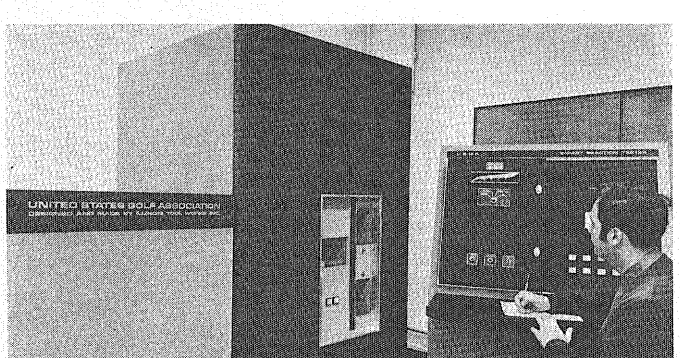
What's New

...in Science and Engineering

Golf Goes to College

A new golf ball testing machine created for the U. S. Golf Association is undergoing extensive tests at Polytechnic Institute of Brooklyn in New York. Designed and built for the U.S.G.A., by Illinois Tool Works, Inc., the new machine will become the national standard tester for golf balls manufactured in the U. S.

The Institute's Mechanical Engineering Department is testing the performance of the new "Variable Speed Impact Reaction Tester" that measures a golf ball's coefficient of restitution, or liveliness.



The machine can run at variable speeds and has a built-in computer which measures the ball's speed over a short course, compares it with the speed of the striking mechanism, and thereby determines the liveliness of the ball. A machine currently used for standard U.S.G.A. ball tests can hit balls at only one striking speed.

Enzyme-attacking Insecticides

Scientists at Honeywell Inc., while exploring odor-detecting mechanisms in nature for clues to better electronic control equipment, have discovered that insecticides may kill by attacking an energy-producing enzyme.

Investigations have led researchers to postulate that chlorinated hydrocarbons—the chemicals used in DDT, Chlordane, Lindane and other pesticides—attack certain enzymes operating in the conversion of the energy foods to useful chemical energy.

This inhibition process may drastically change cellular energy production and nerve action. If the theory can be corroborated by electrophysiological, physiological and biochemical tests, a standard toxicity test based on the known effects of these enzymes appears feasible.

Experimentation confirmed that chlorinated hydrocarbon insecticides inhibit the action of an enzyme that produces chemical energy.

Before an effective toxicity test can be devised to control insecticide contamination levels in lakes, streams and forests, much additional research will be needed on other variables, such as specific reactions and detoxification rates of exposed animals, types of organs affected and kinds of tissues most affected.

The suspected enzymes' called adenosine triphosphahatase (ATPase) enzymes, are important in several metabolic processes, including the conversion and storage of food energy into chemical energy. Sodium-potassium ATPase is found exclusively in plasma membranes and plays a major role in maintaining the electrical potential across nerve-cell membranes.

The lethal hyperactivity commonly seen in cockroaches exposed to DDT concentrates may be associated with the inhibition of magnesium ATPase. In chlordane exposure the opposite effect was noted: there was a strong inhibitory effect on sodium-potassium ATPase, and the insect seemed to be paralyzed, as if a nerve had been short circuited.

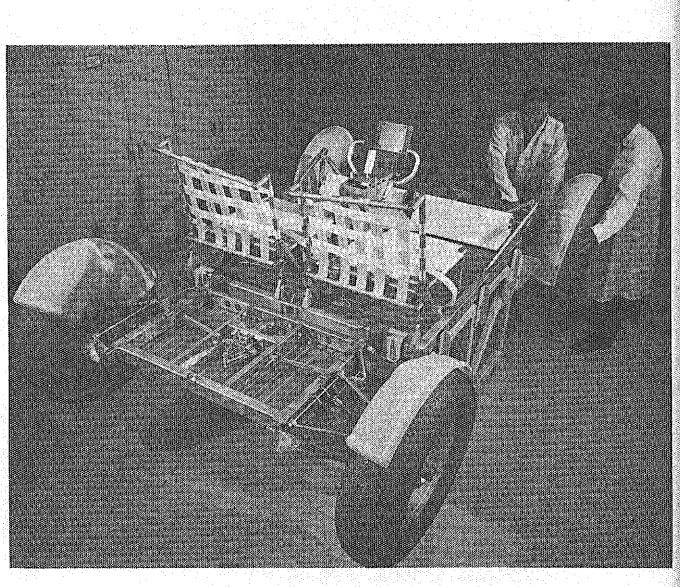
Lunar Rover Testing

Boeing has begun vibration testing of a Lunar Roving Vehicle unit, a close copy of the vehicle which will be used by astronauts for extended moon exploration.

Under test at the company's Space Center is a vibration test unit which is mechanically similar to the Lunar Rover. Simulated weights are used to represent the electrical and electronic components.

The test, which will be run during a two-month period, will simulate both the vibration of a Saturn V launch and the vibration anticipated during lunar operations. The test is designed to uncover any weaknesses in the Rover's structure.

During the launch from Earth the Lunar Rover will be compactly nestled in a cargo bay at the bottom of the Lunar Module. Deployment on the moon by the astronauts will be a semiautomatic procedure.

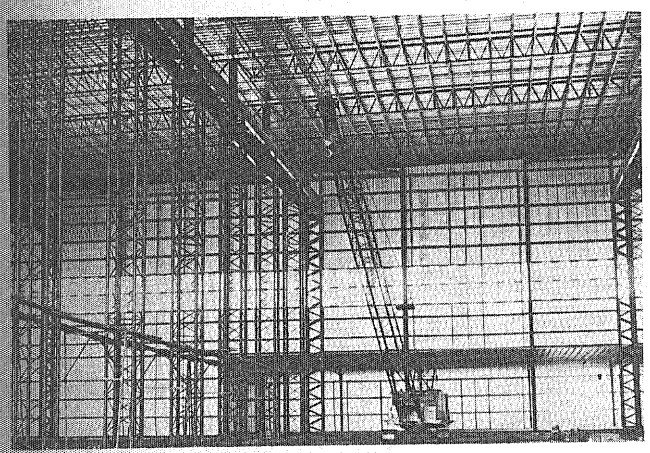


The vibration test unit has been equipped with strain gauges and accelerometers, devices which will chart the stresses the Rover undergoes.

The first of four Lunar Rovers is scheduled to be carried on the Apollo 16 lunar mission in mid-1971.

Mammoth Metal Monstrosity

A huge construction crane is almost lost in the vastness of this 800 by 400 foot metal building system. To the top of the eave it is 80 feet (approximately seven stories high). The mammoth facility contains 25,600,000 cubic feet of space and may well be the largest facility ever erected with a metal building system. It is being built by the Butler Manufacturing Company, and will be used to fabricate offshore oil rigs and other marine equipment.

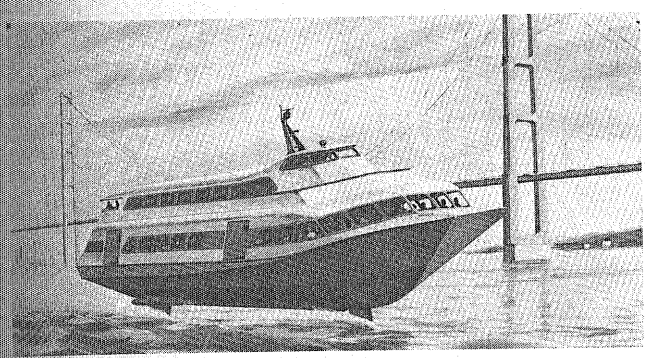


Boeing Hydrofoil

Boeing hydrofoils have been selected as key elements in an urban transportation system proposed for the San Francisco Bay area.

The purpose of the study was to develop a water transportation system for commuters and tourists between Marin County and downtown San Francisco to relieve traffic on the Golden Gate Bridge.

The hydrofoil design is one of a family of passenger-carrying hydrofoils Boeing is studying. The craft, 93 feet in length with a 35-foot beam, is designed to carry 300 passengers at a cruising speed of 40 knots.



The Boeing model would be powered by two gas turbine engines, each driving a water-jet pump.

Bay Area officials have indicated that the target date for operation of a new transportation system is mid-1972.

Electron Surf Riders

Electrons carried at the speed of light on a surf of microwaves surge through the new linear accelerator at the University of Minnesota Hospital. Controlled at the end of the accelerator, the electrons are beamed at cancer tumors.

Installation of the accelerator, constructed in Tokyo by the Toshiba Electric Co., Ltd., was completed in August. The $300,000 machine has the potential of 13 MeV (million electron volts of nuclear energy).

Microwaves generated in the accelerator start at half the speed of light. Then the waves are injected into a wave guide and through an accelerator tube which brings them up to the speed of light. Electrons meeting these waves at the beginning of the accelerator tube are swept along on the waves as riders.

At the patient's end of the unit, the beam of electrons can be focused into any rectangular shape that is needed. A target at this point is shifted to convert the beam to either electron or X-ray radiation treatment. A control unit outside the therapy room determines which type of radiation is delivered in such a way that it is impossible to deliver the wrong type.

High doses of radiation at the proper energy levels are then used to treat both surface and deep-seated tumors.

Technical Information Service

The University of Minnesota libraries are now administering a non-profit information service for Minnesota business and industry.

The new service is called the Technical Information Service (TIS). TIS services include: photocopying materials from the University library collections; providing factual information from published sources; and referring complex information needs to an authoritative source.

TIS will give quick access to information centers of the University, the federal and state governments, and to other organized information agencies. Charges are on per cost basis and are estimated at the time of request.

Additional information is available by writing the: Technical Information Service, Walter Library, University of Minnesota, Minneapolis, Minnesota 55455.

SPLINTERS From the Log

by RALPH POLKINGHORNE and BARRY JOHANSEN

—vilitas et crudus semper ternam

1st M.E.: "Going around with a lot of women keeps you young."

2nd M.E.: "How's that?"

1st M.E.: "I started going around with women two years ago when I was a freshman, and I'm still a freshman."

• • •

Prof.: "Tell me what you know about nitrates."

Student: "I don't know much about them except that they're cheaper than day rates."

• • •

And speaking of gambling, Marriage is like a Poker game. It starts out with a pair, he shows a diamond, she shows a flush, and they end up with a full house.

• • •

There was an old woman who lived in a shoe,

She had so many children that her A.D.C. check came to $1,346.43.

• • •

1st Ag. Eng.: "I don't like the new girl down the block, her neck's dirty."

2nd Ag. Eng.: "Her does?"

• • •

A report is being circulated that a thief broke into the electorial college records office and made off with the complete results of our next presidential election.

1st Eng.: "Well, did you follow my advice and kiss your girl when she least expected it?"

2nd Eng. (with black eye): "My god, I thought you said *where!*"

• • •

Ted: "I'm looking for a girl who doesn't drink, smoke or have any bad habits."

Ned: "What for?"

• • •

A new law has been passed in Russia so that consenting adults can now do to each other what the government has been doing to them for years.

• • •

Papa Bear: "Who's been drinking my beer?"

Mama Bear: "Who's been drinking my beer?"

Baby Bear: "Barf"

• • •

Just a note from Pope Paul: Priests may date nuns, just so they don't get into the habit.

• • •

Sign at Flying Cloud Airport: Notice! Absolutely no flying permitted over nudist camp exactly 8.35 miles from the base on a true course of 190°.

The boy was like any boy. He liked to do his share of the pranks on Halloween. During their rounds, he and his friends turned over a small house in his back yard. (The house was the kind having a crescent-moon-shaped opening the in the door.)

The next morning the boy's father was furious over what had happened the night before. The following conversation ensued:

Father: "I wish I knew who turned the house over last night."

Son: "I cannot tell a lie, Father, I did it."

Son: (After a very painful trip to the woodshed) "Father, you shouldn't have whipped me. George Washington was truthful when he cut down the cherry tree, and his father didn't punish him."

Father: "Yes, but George Washington's father wasn't in the cherry tree."

• • •

Chem. Prof.: Name a liquid that won't freeze.

27 Frosh together: Hot water.

• • •

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

• • •

C.E. (in bookstore): "How much is this paper?"

Clark: "A dollar fifty a ream."

C.E.: "Yea, it sure is."

• • •

Nine out of ten doctors who tried Camels, prefer women.

• • •

And then there was the poor snake who didn't have a pit to hiss in.

• • •

"I hear you've been to a school to cure your stuttering. Did it help?"

"Peter Piper picked a peck of pickled peppers."

"Hey, that's great!"

"Yes, but it's h-hard to work into a normal c-c-conversation."

What is Mechanical Engineering at Minnesota?

by Richard C. Jordan

The distinguished scientist and engineer, Von Karman, expressed it well when he said, "Scientists explore what is and engineers create what has never been." Mechanical Engineering at Minnesota is an exciting field and its students are preparing themselves for a variety of positions both technically sophisticated and socially important. The department has long recognized that during the last one-third of this century some of the most important activities of the engineer will be those that solve engineering systems problems interrelated with the problems of society.

For administrative simplicity the department is divided into several divisions and students participate in the activities of most areas. The Particle Technology and Environmental Division is concerned dominantly with the problems of the human environment; Minnesota has been nationally recognized for its activities in this field for more than 40 years. A research team from this division pioneered an aerosol particle air-pollution studies of the Los Angeles basin a year ago and this study is continuing. More recently the group has also been involved in research which will hopefully lead to solutions of the environmental problems in mines; this work is sponsored by the U. S. Bureau of Mines.

The Heat and Mass Transfer Laboratories and Division is unexcelled in this or any other country and the staff and students have participated in exciting thermal problems ranging from rocket nose-cone recovery and high temperature plasmas to high heat flux rejection from power systems and the resulting thermal pollution.

Industrial Engineering is a division of Mechanical Engineering at Minnesota, but offers separate graduate degrees at the masters and doctorate level. This division is concerned with economic production, optimal systems of operation, effective work methods and measurement, production standards, administration of wage incentive and cost reduction programs, management, and a host of similar problems surrounding industry.

The Design Division of the Department departs from the classical approach to mechanical design and has developed an interdisciplinary program which involves not only other engineering departments, but other areas of the University. This division attempts to face students with sophisticated systems problem which require both technical and social trade-offs in arriving at optimal solutions. For example, one exciting problem with which students have recently been involved concerns solutions to urban transportation problems using both conventional and unique methods of packaging and moving people.

The Power and Propulsion Division has been concerned with the development of both classical and unique power systems as well as the improvement of conventional power units so that their operation is more compatible with the environment.

The Engineering Graphics Division has been involved with the problem of communications, not only graphics in the classical sense but with computerized graphics as well as the inter-relationship of graphics with other forms of communication.

The Bio-engineering Laboratories activities is truly inter-disciplinary between medicine and engineering. It has long recognized that the cardio-vascular system involves a highly sophisticated fluid mechanics-engineering-medical interplay and their many contributions are pointing toward practical mechanical heart systems, implantable devices for long-term injection of pharmaceuticals and the cryogenic preservation of whole blood.

In short Mechanical Engineering is an exciting area of professional study with a broad range of outlets in fields involving virtually every industrial activity current or conceivable in the world today.

What are Physics and Astronomy at Minnesota?

by M. Hamermesh

The School of Physics and Astronomy trains students in a wide variety of fields of research. Before World War II the main interests were in nuclear physics and mass spectroscopy. After the war, very active groups began to appear in cosmic ray physics, upper atmosphere studies, solar physics, high energy physics and low temperature phyics. The most recent area of expansion of interest has been in infrared astronomy.

The Department operates a 30-inch telescope at O'Brien Observatory on the St. Croix River. Observations are made in the wavelength region from 1 to 20 microns (1 micron = 10^{-6} meters). A whole variety of studies have been carried on. One study followed the cooling of different crater areas on the moon's surface after lunar nightfall. It was found that after an initial fast drop, the temperature remains constant through the lunar night. This suggests that these regions contain hot parts having different thermal properties from the surrounding regions.

Infrared emissions in the 3-14 micron range have been observed from the envelopes of cool stars.

Recently, observations on Comet Bennett 1969 showed a blackbody continuous spectrum plus a sharppeak at 10 microns which is attributed to the presence of silicate grains.

The possibility of identifying molecular species from infrared studies of solar, galactic and extragalactic sources is a wide new field of study. To extend this research the University of Minnesota has joined with the University of California (San Diego, La Jolla) to build a new observatory on Mount Lemmon in the Catalina Mountains of Arizona. The 60-inch telescope for the new site is almost completed and we hope to have the observatory in operation within a year. There observations will be possible over a wide range of wavelengths up to 500 microns in the far infrared region. This instrument will make possible detailed investigation of cool objects and studies of molecular species.

Aside from its research use, the new observatory will provide a training ground for students from Minneapolis, La Jolla and the British Science Research Council (which has also contributed funds for the facility).

Along with the development of these new facilities, the School of Physics and Astronomy is increasing its staff in the field of astrophysics and broadening its course offerings in this area. In addition to specialization in this field, it offers many courses that would be of interest as electives for students in I.T.

When you can hardly hear yourself think, it's time to think about noise.

Noise won't kill you. But before it leaves you deaf, it may drive you crazy.

Noise is pollution. And noise pollution is approaching dangerous levels in our cities today.

People are tired of living in the din of car horns and jackhammers. They're starting to scream about noise.

Screaming won't help matters any. But technology will. Technology and the engineers who can make it work.

Engineers at General Electric are already working to take some of the noise out of our environment. One area where they're making real progress is jet-aircraft engines.

Until our engineers went to work on the problem, cutting down on engine noise always meant cutting down on power. But no more.

GE has built a jet engine for airliners that's quieter than any other you've ever heard. A high-bypass turbofan. It's quieter, even though it's twice as powerful as the engines on the passenger planes of the Sixties.

And NASA has chosen General Electric to find ways of cutting engine noise even further.

It may take an engineer years of work before he can work out the solution to a problem like noise in jet engines. And it may be years before his solution has any impact on the environment.

But if you're the kind of engineer who's anxious to get started on problems like these and willing to give them the time they take, General Electric needs you.

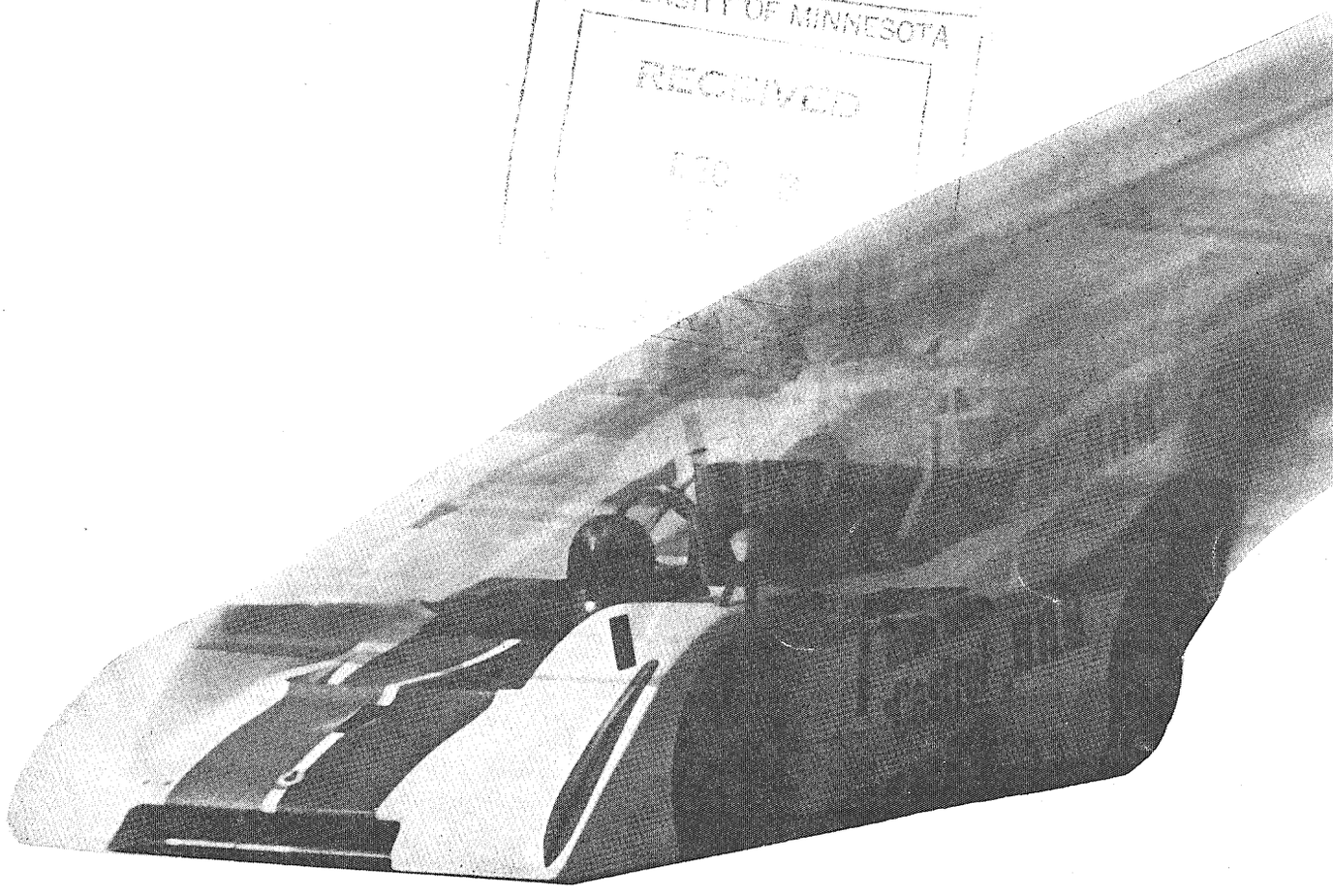
Think about it in a quiet moment.
Or, better yet, a noisy one.

GENERAL ELECTRIC

An equal opportunity employer

TECHNOLOG

UNIVERSITY OF MINNESOTA NOVEMBER, 1970



Westinghouse the teacher?
the medic?
the builder?
the crime fighter?
the urban planner?
the ecologist?

Westinghouse Learning Corporation has launched a computerized teaching system that lets each child learn at his own rate.

Our studies for the Defense Department will lead to the "hospital of the '70s," and a level of efficiency and economy unknown today.

Houses? We're not talking about the thousands of units completed or under construction. We're talking about the new plant we're building to mass-produce modular houses.

Our computer-based information systems improve police efficiency, speed up court administration. We're marketing electronic security systems for homes and plants.

We've developed waste-disposal units for neighborhoods, sewage treatment plants for cities, a smokeless refuse plant that reclaims rather than destroys.

We're transforming 16 square miles of Florida into a new city. It's the bellwether for hundreds of thousands of acres, bought or leased, here and abroad.

The list goes on. Everything electrical, of course—from nuclear power plants to light bulbs. And aerospace, oceanography, broadcasting, rapid transit.

It all means that Westinghouse has openings for skilled engineers—electrical, mechanical, chemical, industrial. And we also offer job training for the unskilled as another step toward increasing productive employment for the disadvantaged people of our country. An equal opportunity employer.

You can be sure...if it's Westinghouse

"There's a little more freedom here to direct my own research than at most company labs."

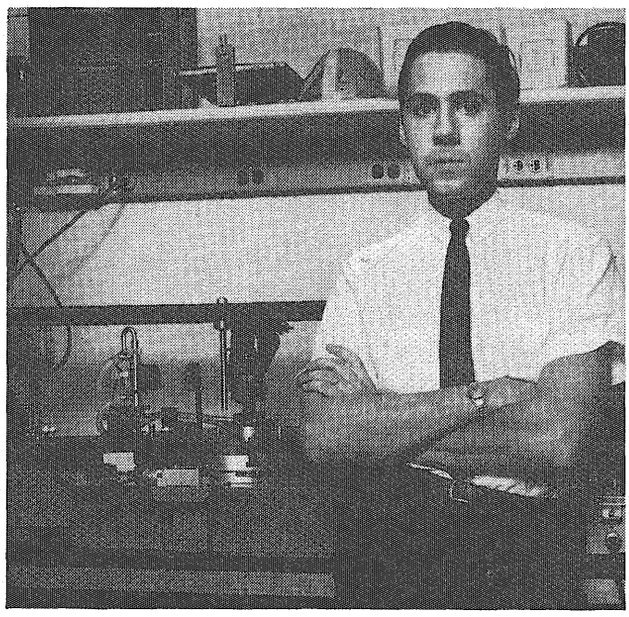
Bob Pfahl, Western Electric

Thermal energy is his field. And since 1968, Bob Pfahl has been doing research and development in radiant heat transfer on the staff of Western Electric's Engineering Research Center.

Well-backgrounded, Bob holds three degrees from Cornell University—a bachelor's in mechanical engineering, and a master's and doctorate (received in 1965) in heat transfer.

"My job is self-motivating," said Bob. "I have to look ahead to see where I think research should be done."

And one such area was the design of heating equipment. Western Electric uses radiant heating in a variety of manufacturing processes because it's quick and inexpensive, and because it can be applied at a distance.



However, because of the limitations of existing reflectors, radiant heating has been limited to small areas. Bob has developed a reflector shape which uniformly distributes energy from a compact mercury arc lamp over larger circular areas.

"Many projects grow out of previous or existing work," Bob said. He explained that in order to calculate the reflector shape, he had to first design an instrument to measure reflectance of the reflector material.

"But we're well supported here at Western Electric," said Bob. "We have very fine lab equipment—and can obtain the equipment we need."

So Bob designed and built his "spectral bi-directional reflectometer." It provides data for a computer program he created that calculates reflector shape by numerically integrating a set of differential equations.

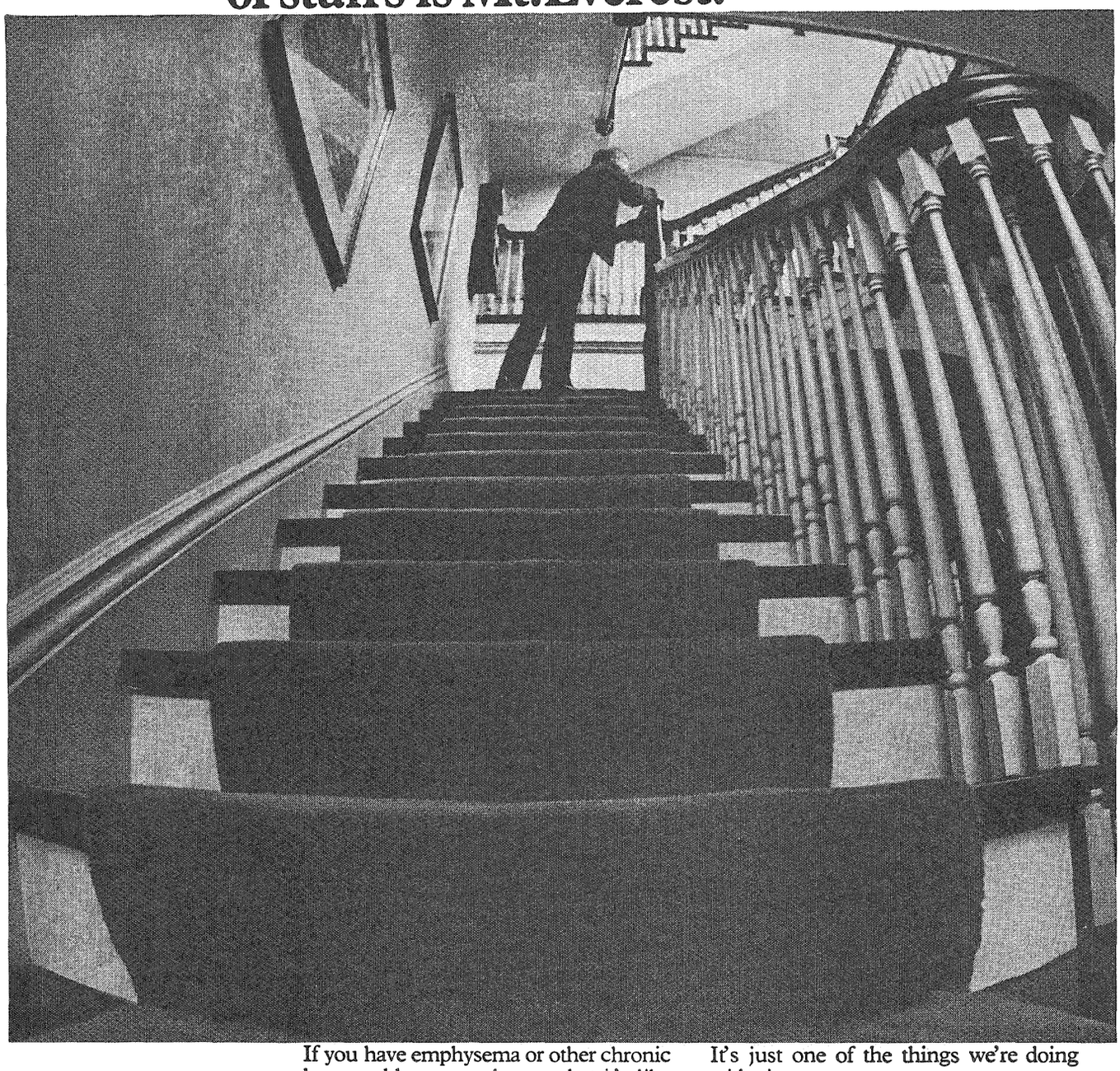
Bob is currently working on the development of an even newer type reflector which will distribute energy from line type filament lamps over a large rectangular area. An array of these reflectors will allow the uniform heating of almost any size workpiece.

"We're free to look around for our own projects," said Bob. "I like that—that's why I'm here."

Western Electric

An Equal Opportunity Employer

To a man with emphysema, a flight of stairs is Mt. Everest.



If you have emphysema or other chronic lung problems, you know what it's like to climb a flight of stairs. And you probably don't know what it's like to play a round of golf or even take a walk.

Union Carbide's Linde Division has developed a portable liquid oxygen system which many doctors prescribe for their patients.

It weighs less than 9 pounds full. Set the oxygen at the flow your doctor tells you to. And you can do many of the things you did before.

Sure, we've oversimplified the whole thing. We're not going to go on and on about all the Union Carbide technology that makes the Oxygen Walker possible. It's just one of the things we're doing with air.

We separate and purify nitrogen, argon, neon and krypton for industry. We make liquid nitrogen systems for everything from refrigeration to surgery. We make mixtures for underwater divers.

It makes sense that if we can help a diver dive to 1000 feet, we can give a man with emphysema the air to get to the top of the stairs.

UNION CARBIDE

THE DISCOVERY COMPANY
270 Park Ave., New York, N.Y. 10017

For additional information on our activities, write to Union Carbide Corporation, Department of University Relations, 270 Park Avenue, New York, New York 10017. An equal opportunity employer.

TECHNOLOG

VOL. 51, NO. 2 | Official Student Publication of the Institute of Technology, University of Minnesota | NOVEMBER 1970

FEATURES

DEPARTMENTS

ABOUT THE COVER: The cover photo is a BMR race car taken at the Donnybrooke Can-Am race. Cover photo and design by Don Neal.

MEMBER OF ECMA

Published monthly, October through May. Second-class postage paid at Minneapolis, Minnesota. Office: Room 2, Mechanical Engineering Building, University of Minnesota, Minneapolis, Minnesota 55455. Telephone: 373-3298. Printer: Bruce Publishing Co., 2642 University Avenue, Saint Paul, Minnesota 55114. Publisher's National Representative: Littell-Murray-Barnhill, Inc., 369 Lexington Avenue, New York, New York 10017 and 737 North Michigan Avenue, Chicago, Illinois 60611. Publisher's State and Local Representative: University Engineering Magazine Advertising, F. P. McGrath Manager, Box 14026 University Station, Minneapolis, Minnesota. Telephone 612-225-0708. Member of the Engineering College Magazines Associated, Gordon Smith, Oklahoma State University, Stillwater, Oklahoma. Subscription rate: $3.00 per year, single copies 50 cents. Advertising rates upon request. Any opinions expressed herein are not necessarily those of the Institute of Technology or of the University of Minnesota.

"...I'm kind of a marriage counselor for the ocean..."

Vic Taylor is a corrosion specialist for International Nickel at its testing lab in North Carolina.

"...That old ocean doesn't like us sometimes. She rusts boats, eats away metals, destroys coatings... what we're trying to do is come up with alloys she can live with."

Inco's Francis L. LaQue Corrosion Laboratory, at Harbor Island, N.C., is testing materials needed for ocean engineering, desalination plants, water and sewage treatment facilities, bridges, boats, even houses. Testing not just nickel alloys, but 40,000 specimens of materials from many industries. Alloys, fabrics, coatings.

"...Remember how car bumpers used to corrode? Now it's a different story. And we're applying this knowledge to many industries. Making pollution control equipment, for instance, stand up longer than anyone thought possible."

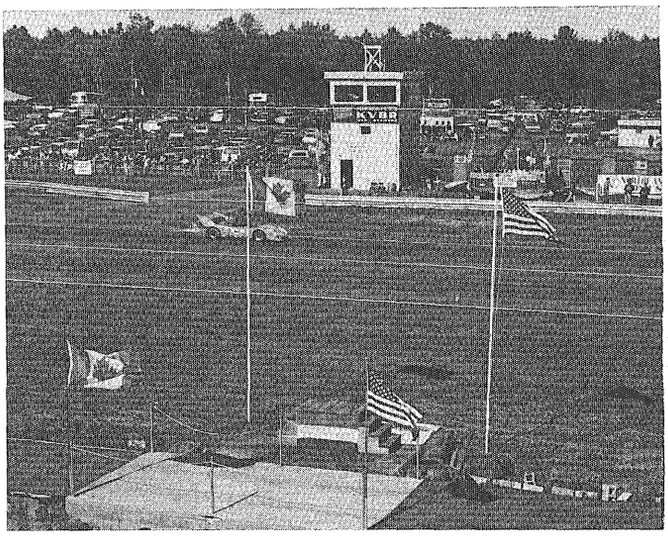
Undreamed of advances are what Inco men are working for. Men who develop alloys, test them, search the world for more nickel. Nickel, the metal that makes other metals stronger, tougher, more corrosion resistant. Nickel, its contribution is quality.

INTERNATIONAL NICKEL

The International Nickel Company, Inc., New York, N.Y.
The International Nickel Company of Canada, Limited, Toronto, Ontario
International Nickel Limited, London, England

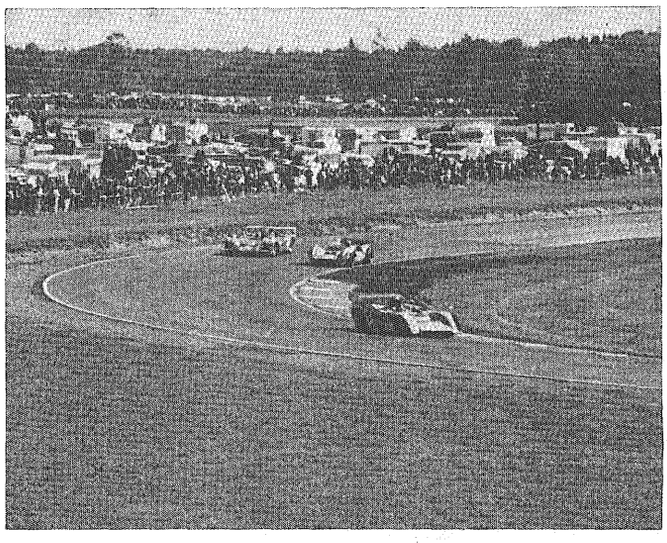
Vic holds a nickel-chrome plated automobile bumper which was tested in the corrosive seaside atmosphere.

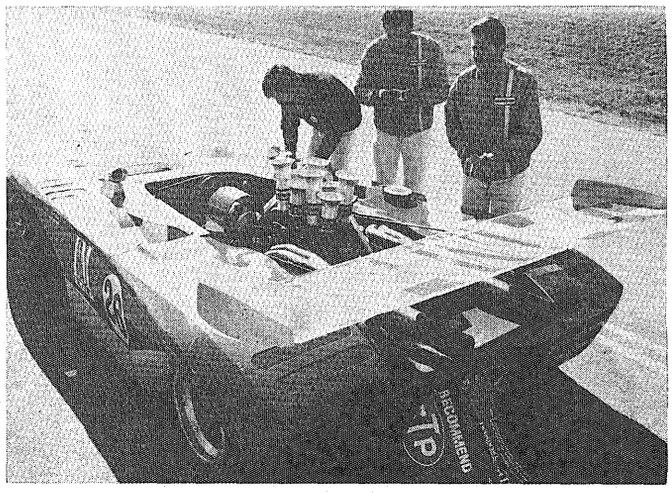
Photography by W. Eugene Smith.



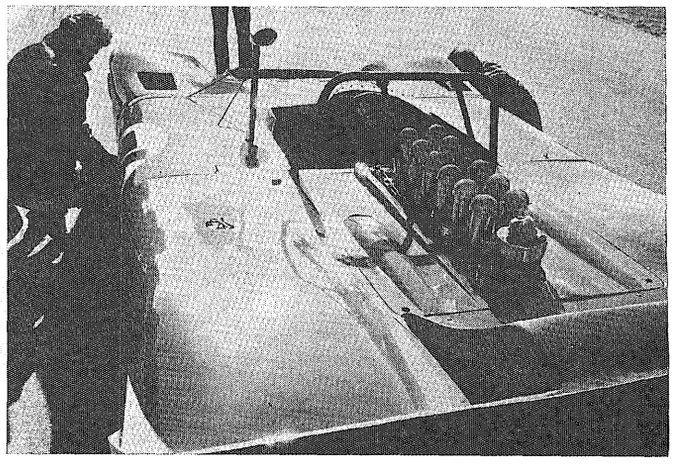
Donnybrooke

The Canadian and American flags reign over the starting line as three racers pass the control tower. (Below) Half a million dollars worth of machinery round turn 6.

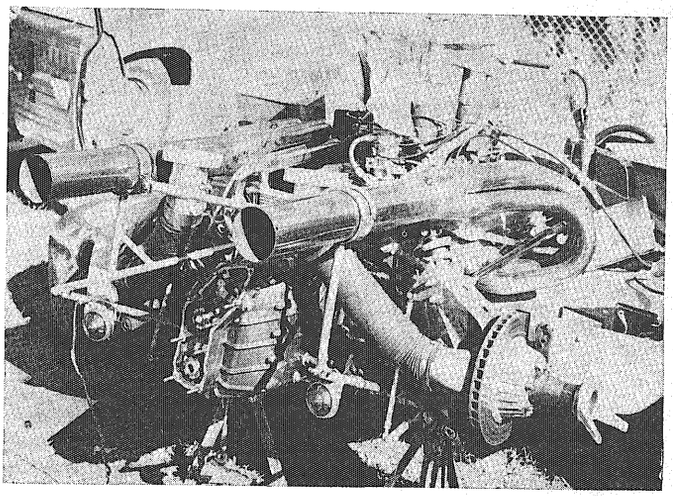




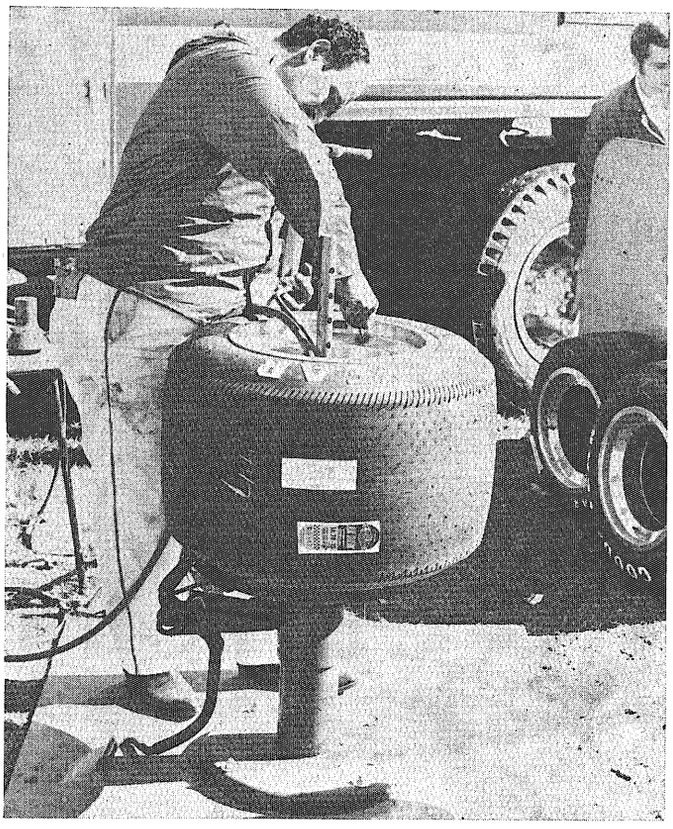
Last minute inspections are made prior to the race. The twelve intake stacks on the car below distinguish the Ferrari from the Chevrolet engines powering most of the Can-Am racers.

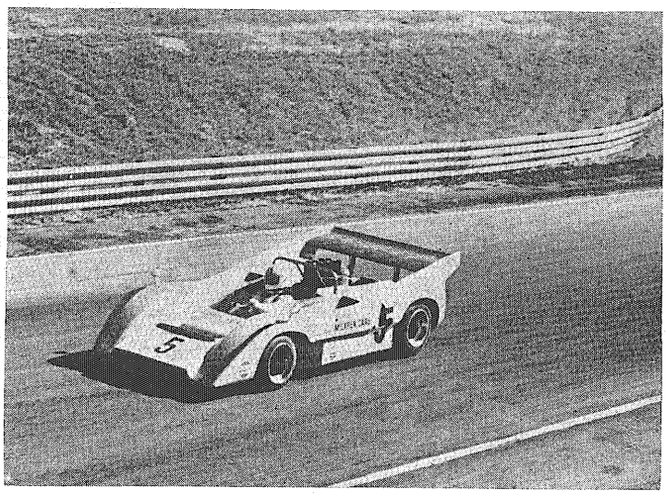


Can-Am

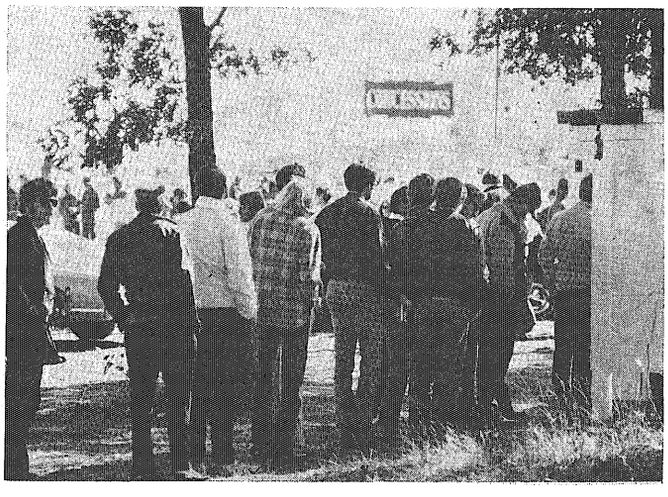


A close-up detail shot of the drivetrain of a Can-Am racer. Notice the cooling duct running from the center of the brake hub. (Below) A tire is mounted for one of the racers.





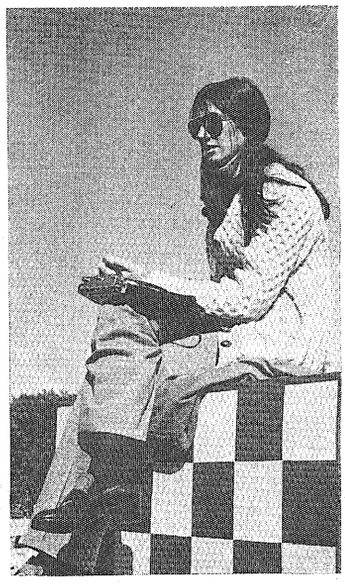
Denis Hulme rounds the track as spectators suffer the consequences of drinking too much beer. Actually this line wasn't so bad compared to the woods.



Photos by
Don Neal

The Girls of Donnybrooke

The other popular sport at Donnybrooke involves participants and spectators. Watching the spectators helps to pass the time between events. These spectators had a special interest in the race, as evidenced by the clipboards and other accessories used by members of well-equipped pit crews.



If you don't like the way people talk to each other, we'll pay you to change it.

We're in the communications business.

And during the next 30 years we're going to upgrade all the equipment we now have in order to provide even better service to our 6 million existing customers.

As if that weren't enough we're also going to have to come up with enough new equipment to provide telephone service to about 26 million more people. As well as equipment for a much more extensive data communications program.

We need enough people (electrical, civil, mechanical and industrial engineers, designers, accountants and economists) to plan, design, build and operate a company that will be four times bigger than we are today. We also need engineers, researchers and scientists to develop electronic switching equipment, laser and other communications systems we'll be using 10, 25 and 50 years from now.

But this is only one part of our communications business.

Our Sylvania people, for example, are involved in other types of communications. Like color television sets, satellite tracking stations and educational television systems.

Automatic Electric, Lenkurt, Ultronic Systems and some of our other companies, subsidiaries and divisions are working on advanced types of integrated circuitry, electro-opticals and communications systems between people and computers and between computers and computers.

So if you think you have something to say about the way people talk to each other . . . we're ready to listen.

General Telephone & Electronics

Equal Opportunity Employer

Sylvania Electric Products • Lenkurt Electric • Automatic Electric • Telephone Companies in 34 States • General Telephone Directory Company • General Telephone & Electronics Laboratories
General Telephone & Electronics International • GT&E Data Services • GT&E Communications

Logline

Library in a Bind

The Engineering Library is facing a financial crisis. Books have been disappearing and thus causing inconvenience for students and forcing the library to further cut an already limited budget. Book check-out has always worked on the honor system. This policy not only creates a feeling of freedom, but allows library personnel to perform other duties. If books keep disappearing, this policy will have to be changed.

If anyone has books that are not checked out, please return them. No questions will be asked.

Who Took It?

Where, Oh Where, is Our B-Rock

When in the course of engineering events it becomes necessary for one group to dissolve bonds of student fellowship and express dissatisfaction with another group for results unexpected and beyond their control, it seems to be acceptable to strike back at the second group rather than to maturely try to understand the circumstances perpetrating the disastrous result.

Prove me wrong.

Item: Last year's E-Day cancellation was disastrous, disappointing, and frustrating. Agreed.

Item: No one lost more, was more disappointed, or was more turned off than those who sincerely worked to make it a success to share with all IT students.

Item: After E-Day last spring, the Blarney Stone of the engineers was stolen by a group of engineers in lieu of a successful E-Day.

FACT: Nothing was accomplished by this asinine act of childish frustration.

I hope they're proud of themselves: proud of their cuteness; proud of their destructive attitude; proud of their apathetic, ineffective, obstinate exercise in egotistical self-satisfaction.

Where are you now as plans are developing for next spring's E-Day?

Anyone can destroy and criticize.

What can you do to help?

Robert Plumb

Minnesota Jobs

As one examines the statistical data on employment opportunities for engineers such as reported in the October issue of Technolog (Logline—Job Opportunities) one must keep in mind that these are often nation-wide statistics.

The data of the I.T. Placement Office of the University of Minnesota presents a much more optimistic picture of what happened to Minnesota I.T. graduates in 1970. Between September 1, 1969 and August 1, 1970, almost 80% of graduates at the bachelor's level had found positions. After August 1, 1970, there were very few reports of inability to find positions by 1969-70 graduates. The average I.T. graduate received almost three job offers at an average salary of $866 per month (1968-69—$827 per month). The average salary for an I.T. graduate who remained in Minnesota was $875 per month. Fifty-eight percent of graduates were placed in Minnesota (1968-69—52%). There was an increase from 5 to 8 percent of graduates entering graduate school compared to the previous year and an increase from 5 to 9 percent of those entering the military service.

The number of positions offered did shift from the aerospace and defense industries, but the increases in offers and employment came from non-defense industries, civil service (state, county and federal) and from smaller employers.

There was increased difficulty experienced by holders of advanced degrees as compared to the previous year.

The overall picture, however, was much more satisfactory than that experienced by many other areas of the nation.

A Voice from The Masses

The juxtaposition of coincidentally related articles in the October Logline highlighted a fundamental disorder in the engineering profession. The article describing the decrease in the number of job opportunities abutted the Administration article reporting the largest I.T. Freshman Class in several years. Unless admissions are correlated with demand, engineers will continue to have the least job security of any professionals.

In 1929, engineers' average incomes exceeded those of physicians. During the past decades medical schools have restricted admissions, reducing supply relative to demand with the consequences obvious today. Think about it!

Mike Smayling, EE Sophomore

We welcome and encourage contributions to this editorial column from students and faculty of I. T.

Send responses to:
Minnesota Technolog
Rm 2 ME
U of M

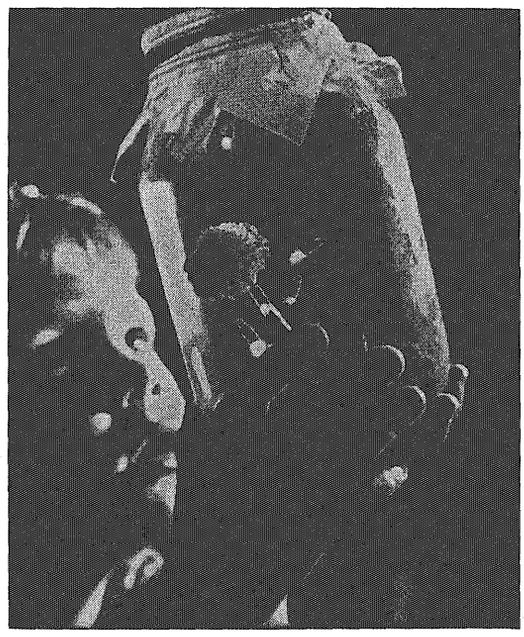
The *lampyridae* beetle family. Delight of small boys. Biological light bulb. And prime source of raw material for another Du Pont innovation.

Luciferase, an enzymatic protein with intriguing properties, obtainable only from fireflies. *Luciferin,* an organic molecule also found in fireflies, but synthesizable. *Adenosine triphosphate* (ATP), a common energy-yielding substance found in all living cells.

Those are the three main ingredients in *lampyridae's* love light. And because ATP is common to all living cells, university researchers discovered they could produce an artificial glow by mixing luciferin and luciferase wherever life is present.

Noting that phenomenon, Du Pont scientists and engineers went on to develop it into a practical analytical system. Correlating the intensity of the artificial "glow" with the amount of ATP present in bacteria, they designed a means of measuring the reaction.

The result is the luminescence biometer—the first really basic improvement in bacteria-counting methods since the days of Louis Pasteur. Rather than waiting days for a culture to demonstrate growth density, a doctor or technician can now get a digital readout of bacteria concentration in a matter of minutes.



Other potentially lifesaving uses for the biometer are being suggested every day—such as diagnosing metabolic rates, enzyme deficiencies and nerve damage.

Innovation—applying the known to discover the unknown, inventing new materials and putting them to work, using research and engineering to create the ideas and products of the future—this is the venture Du Pont people are engaged in.

For a variety of career opportunities, and the chance to advance through many fields, talk to your Du Pont recruiter. Or send the coupon.

Venture: Use a love call to count bacteria.

Du Pont Company, Room 7890, Wilmington, DE 19898

Please send me the booklets checked below.

- ☐ Chemical Engineers at Du Pont
- ☐ Mechanical Engineers at Du Pont
- ☐ Engineers at Du Pont
- ☐ Accounting, Data Systems, Marketing, Production

Name_____

University_____

Degree_____ Graduation Date_____

Address_____

City_____ State_____ Zip_____

An Equal Opportunity Employer (M/F)

DU PONT
REG. U.S. PAT. OFF.

Ventures for better living.

MHD

by Bruce D. Nelson

Magnetohydrodynamics (abbreviated MHD) is a term which some might have seen for the first time while gazing through a recent article on environmental preservation or pollution control. It is an unique concept in electric power generation, and some environmental specialists boast that it drastically reduces all forms of pollution from electric energy production. Also, some day the same concept may be used to transport spacecraft between stars as no engine operating on familiar principles ever could. Power production is the closer and more controversial application of MHD.

In a recent issue of the "Twin Citian" magazine, a well known local environmental spokesman strongly criticized the U. S. electric power industry for their lack of interest in this new generating technique, which not only promises to save them a great deal of money, but also reduces environmental pollution from electric power production. Utilities have not been known in the past to ignore such opportunities to cut costs, so there must be much more to MHD than currentlly meets the environmentalist's eye. In electrical engineering circles today, MHD refers to a technique of energy conversion—kinetic energy to electrical energy via MHD generator and electrical energy to kinetic energy via MHD engine. Literally, the word magnetohydrodynamics means the dynamics of charged particles in a fluidic state within a magnetic field. However, it has come to be applied to the actual means of energy conversion since extensive work began in this area.

The principle of MHD for fluids is based on the same concepts as the "Hall Effect" for solid conductors. Ionized particles pass at high velocity through a narrow channel, and perpendicular to this flow, there exists a strong magnetic field. Under these circumstances, an electric field always exists in the dimension perpendicular to both the flow and the magnetic field.

This phenomenon was first realized by Michale Faraday in the early 1900's. As early as the beginning of the present century, MHD type devices were being considered for development. Decades of basic research in plasma physics and materials' science were needed before any substantial progress toward realization of MHD could be made.

A great deal of development has taken place within the past few years, and some MHD generator and engine prototypes are now in existence. It must be understood, however, that MHD technology is still in its infancy, and practical, large scale installations are still many years and research dollars away. Yet, estimates and calculations have been made on theoretical, full scale MHD generators and engines based upon theory and prototype operations. As in most work of this type, the results may be interpreted in a number of ways. This article is intended to clarify some of the concepts, problem areas, and misunderstandings of MHD devices.

COMPARISON OF TURBOGENERATOR AND MAGNETOHYDRODYNAMIC (MHD) GENERATOR

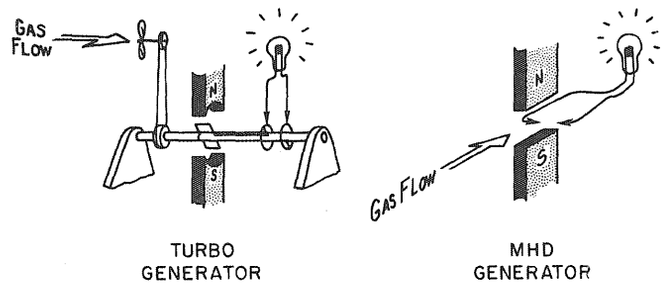


Figure 1.

The figure 1 illustrates the similarity between the basic principles of the MHD and conventional generators. Note that in the conventional generator, the wire

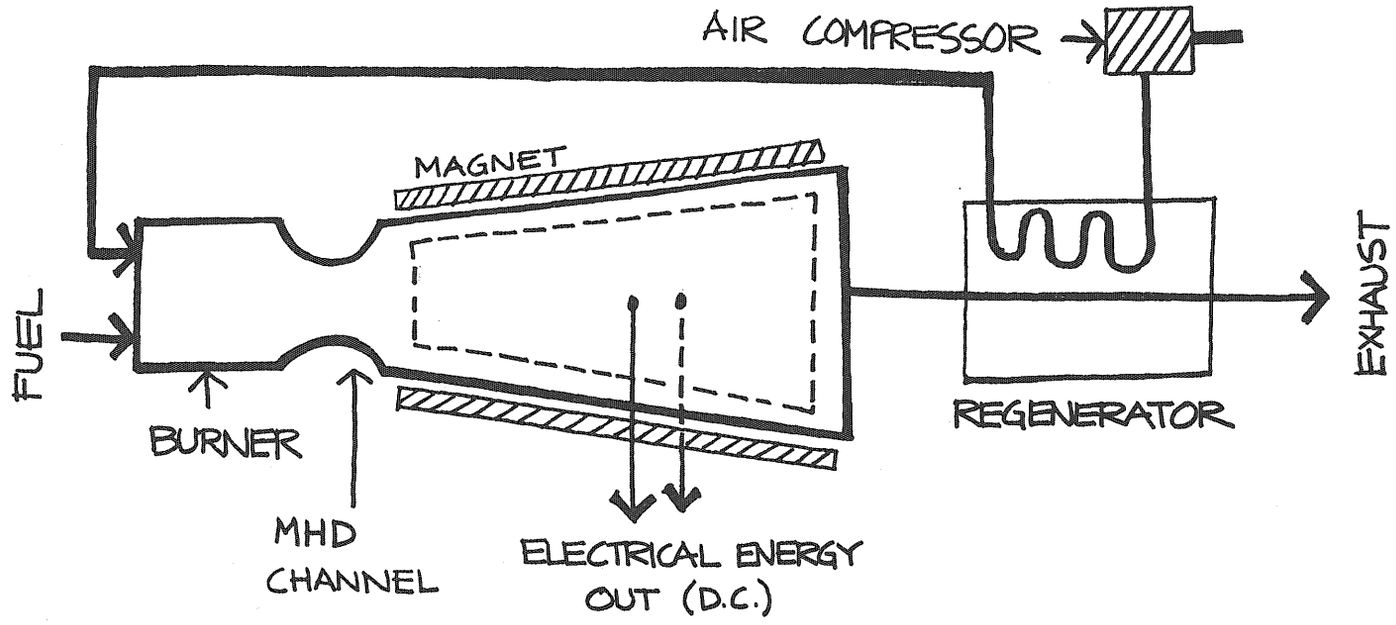


Figure 2. Open cycle MHD generator.

in the armature moves in the magnetic field producing the electric field, whereas, with MHD the ionized gas provides this movement. In its most elementary form, the open cycle MHD device consists of a compressor, heat source, MHD channel and regenerator (heat exchanger). The open cycle generator and engine are schematically illustrated (Figures 2, 3). The concept of "cycle" has been introduced and probably the clearest way to demonstrate its meaning is to illustrate a closed cycle MHD generator (Figure 4). The closed cycle device operates in a recirculating fashion, whereas the open cycle device does not. The fluid which circulates in the system may be either gaseous or "liquid metals" materials, the choice depending on the type of heat source and application.

MHD ENGINE

In the MHD engine, thrust is provided by electromagnetic forces acting upon the ionized fluids as they flow through the channel. Because of this different approach to propulsion as compared to the conventional jet or rocket engine (i.e. electrical instead of chemical reaction), this engine may have some unprecedented capabilities for meeting future high velocity and long

Continued on Page 22

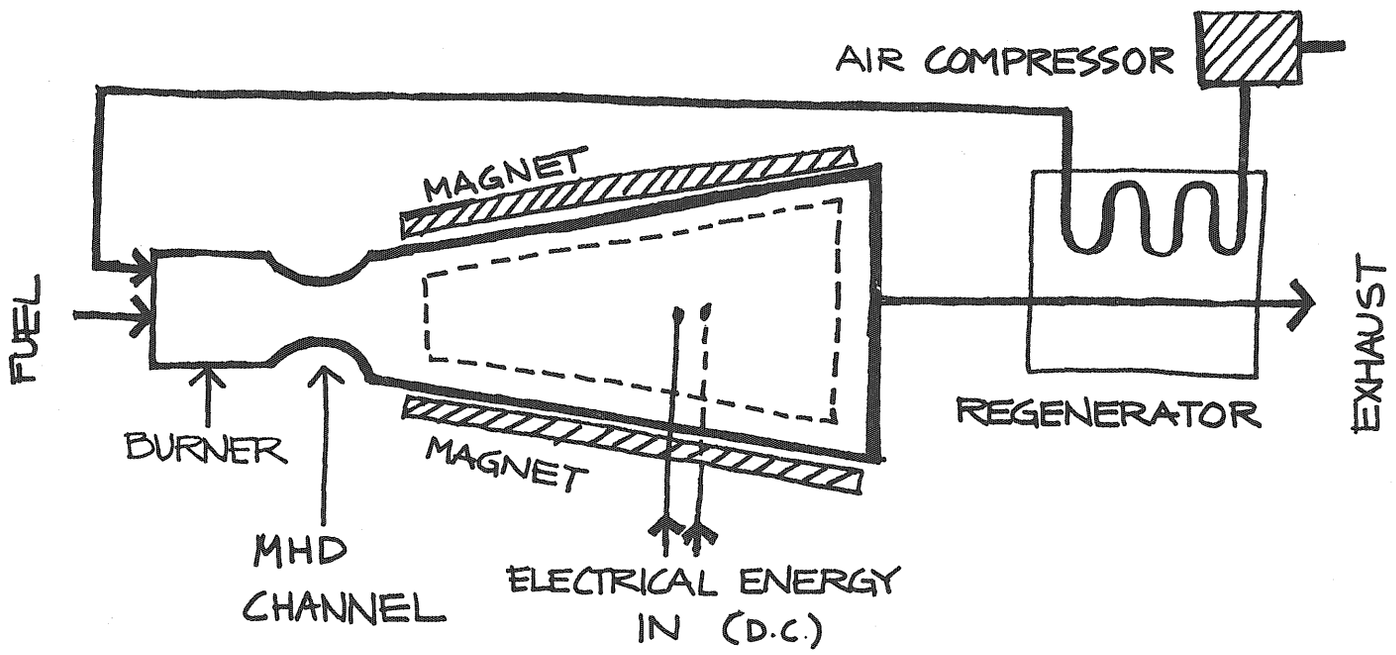
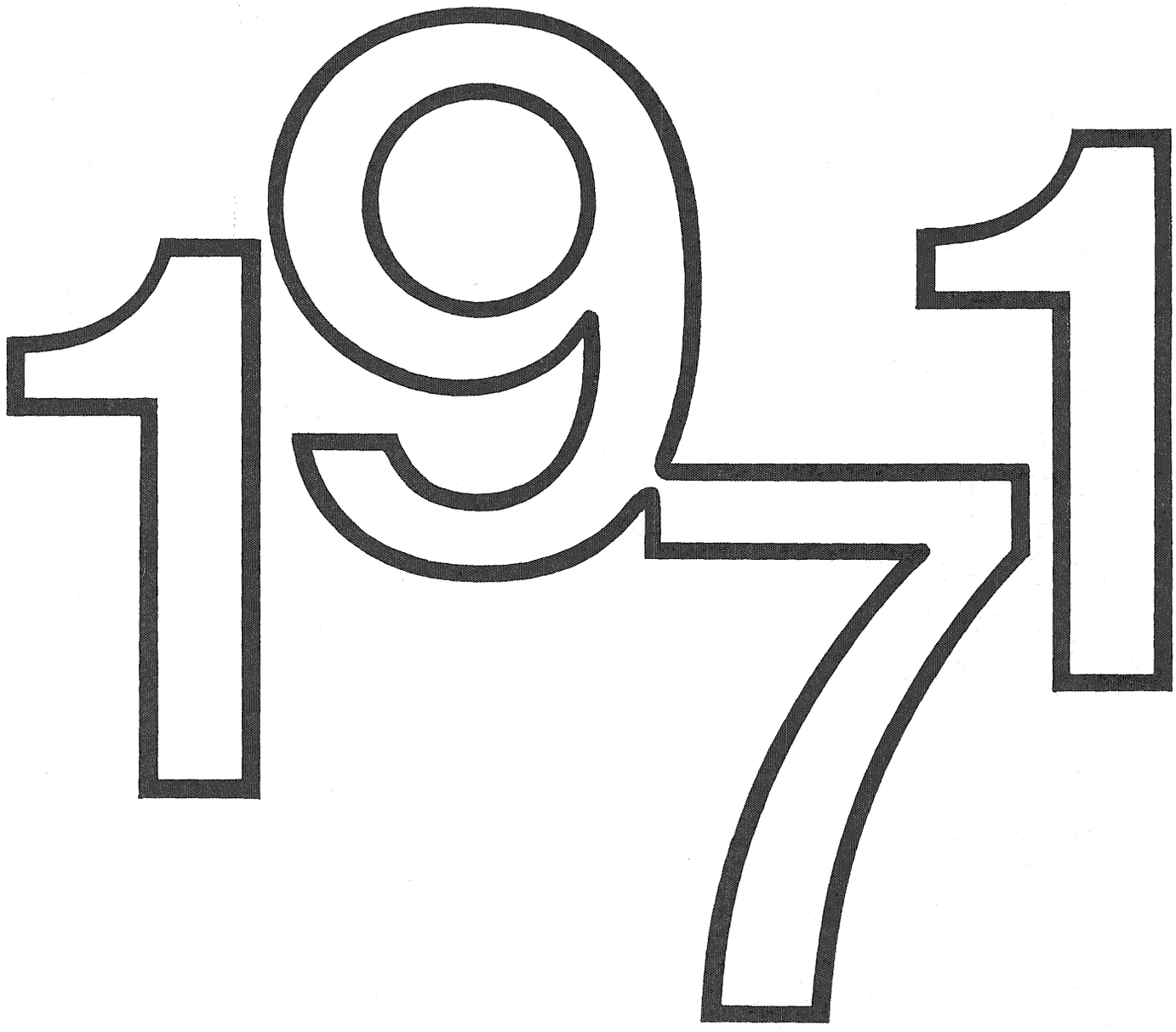


Figure 3. MHD engine.

If you are a senior...



could be the most important year of your life.

As you contemplate one of the most important decisions of your life, you will want to remember this: it is not just "a job" you are seeking—it should be the beginning of a career. And if it is to be successful, both you and your employer must need and want each other.

To help you with your decision, we invite you to consider the opportunities at Pratt & Whitney Aircraft. Currently, our engineers and scientists are exploring the ever-broadening avenues of energy conversion for every environment . . . all opening up new avenues of exploration in every field of aerospace, marine and industrial power application. The technical staff working on these programs, backed by Management's determination to provide the best and most advanced facilities and scientific apparatus, has already given the Company a firm foothold in the current land, sea, air and space programs so vital to our country's future.

We select our engineers and scientists carefully. Motivate them well. Give them the equipment and facilities only a leader can provide. Offer them company-paid, graduate-education opportunities. Encourage them to push into fields that have not been explored before. Keep them reaching for a little bit more responsibility than they can manage. Reward them well when they *do* manage it.

Your degree can be a B.S., M.S., or Ph.D. in: MECHANICAL ENGINEERING • AERONAUTICAL ENGINEERING • ENGINEERING SCIENCE • ENGINEERING MECHANICS.

If your degree is in another field, consult your college placement officer—or write Mr. Len Black, Engineering Department, Pratt & Whitney Aircraft, East Hartford, Connecticut 06108.

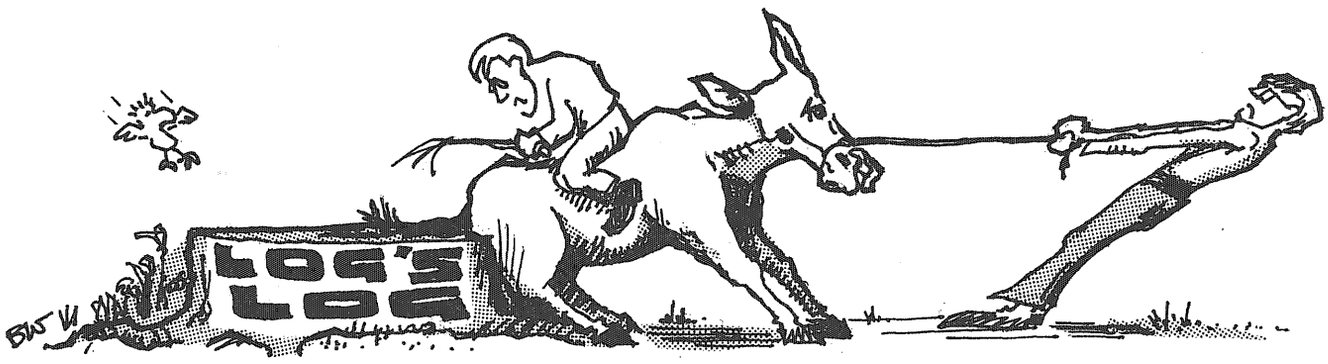
Pratt & Whitney Aircraft

EAST HARTFORD AND MIDDLETOWN, CONNECTICUT

UA

DIVISION OF UNITED AIRCRAFT CORPORATION

An Equal Opportunity Employer



INTRODUCTION

Since our ratings have been calculated to be the square root of "- i" by our triumvirate, the super Log team decided to do something about it. After trying the usual pounding of fists, kicking the desks, and causing general chaos we decided to use our ultimate weapon. Call out the "ROACHES"! ! ! !

Lush's Corner

Welcome back, fellow elbow-benders!! This month's topic is that Roachian favorite, Vodka.

Everyone knows that Vodka comes from potatoes, but the real truth is that most of today's domestic is made from fermented grains, which are distilled and diluted from 190 proof to the usual 80-110 proof, filtered through charcoal, and bottled. You can make a reasonable imitation by adding a little water to ethyl alcohol (undenatured).

Probably the greatest asset of Vodka is that besides being a good straight, it mixes better than a gob of mustard at a weenee roach. Charged water, soda pop, and fruit juices are all good friends to Vodka.

The biggy for this month (dug up by the Log expeditionary force in charge of little known and better forgotten facts) is called "Skip-and-Go-Naked." You add one jigger of Vodka to approximately 10 ounces of beer in a large glass. Fill the rest of the glass with thawed-out frozen concentrated lemonade. Stir well and the rest is up to you. Just remember—we take no roachsponsibility for the condition of your head the next day!!

The Pinko-Pickle Revealed

or

CAUTION: Pickles may be hazardous to your health.

The expeditionary force, research extension, has just dug up the astounding fact that pickles are in reality a Commie-pinko plot to destroy us all. According to the investigation team, pickles cause death, increased crime, war, and general indigestion. Examine the facts for yourself.

1. 94.27% of all people who were in auto, boat, or airplane accidents have eaten pickles.
2. 84.27% of all juvenile delinquents have been served pickles by their parents.
3. 99.9% of all soldiers eat pickles more than once a week.
4. 93.58% of the inmates at San Quentin ate pickles within 26.5647 hours before they were captured.
5. All of the people who ate pickles in 1783 are now dead. Now ask yourself, "have I ever seen a Commie-pinko eat a pickle?" Of course you haven't.

The E.F., in an exclusive interview with internationally renounced Lower Lake Street Bamboo Specialists, found out that bamboo refuses to budge after prolonged exposure to pickle juice, and as everyone knows what's bad for the slipstick is bad for the tum tum.

Heed our warning friends and stay away from those little green wrinkles or your body may end up that way (green and wrinkled).

A flash from the E.F. researchers has just informed us that Mom's apple pie is now under investigation. What's going to be next! No one knows what the Commie-pinkos have up their sleeve, but we have nothing to fear, because the trusty Ag. boys are there to protect us (are they anything like foresters?)

Official Daily Bull

Due to the many requests of our reading audience (namely your triumvarate) the expeditionary force has renewed the official calendar of U of M IT social highlights to the swingers and also to the guys in EE.

In order to improve our relations with those who find our trivia nauseating we've added the following special bonus:

There, now wasn't that refreshing. If that wasn't refreshing enough for you just remember you can always use a dime for a screwdriver.

Nov. 16 - 30

16—Ace Day

24—Moon Day. Hang one in your window.

26—Gnivigsknaht Day

30—Alfie tells what it's all about and is sent to his room.

Dec. 1 - 15

1—only twenty-three more shop-lifting days until Christmas

4—Whole Day. Enjoy it with a friend.

11—Fairy Day. Take out a virgin.

15—The Flying Dutchman is shot down. Snoopy reports that it was a bad trip.

The Fearless Feeze

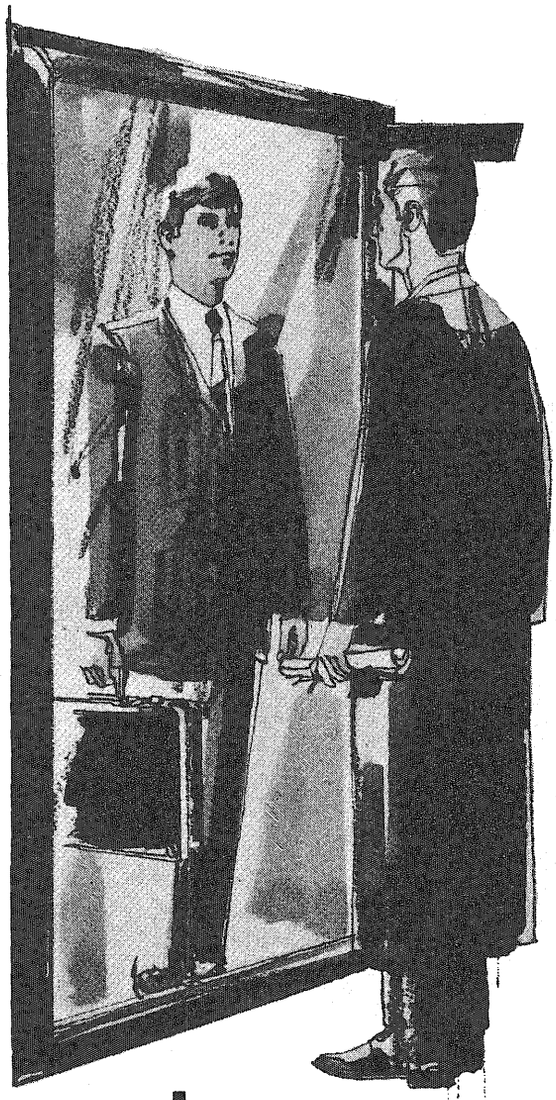
One of the many treasured sayings left to us by our former editor, Dianne Rekow, is "Never criticize secretaries or plant services or the whole damn U will crumble to dust!" Since the incomparable Log's Log team fears nothing (and they forgot to do their Physics homework), we decided to test the validity of our fallen (would you believe thrown out on her tuckus) leader. Plant Services, alias the cobweb crew, with a record worse than Ace (and that's hurting) have already outdone themselves this year. Plant Services is the only group to have patented the most efficient method of being inefficient. Our expiditionary force has set its pop guns on their most glorious custodial streak of genious—Physics 150.

The expeditionary force happens to be among the unfortunate multitude that has been condemned to a quarter of nauseating lectures in that rather charming abode. With the first week of classes, and warm weather, the P.S. (= B.S.) morons decided to test the heating system. As the indoor temperature reached 100°C., our virgin eyes witnessed the greatest take-off of all time. We saw more stripping in five minutes than in an entire night at the "Roaring 20's." Since your heroes are a bright pair, we decided to get into the underground movie business. The next day, equipped with the latest photographic equipment, and the temperature outside in the 40's, this fearless team assaulted the objective. Upon entering and after de-fogging our eyeballs, we were faced with the greatest put-on since the day before the take-off. You see, the cobweb cuties had chosen to unsieze the air-conditioner, so that the temperature in Physics 150 was now appROACHing 0° Kelvin.

One student thought he had mistakingly entered the cryogenic testing lab, while another believed he was in the middle of a Fresca commercial. It was reported that one student had his arm amputated to stave off gaseous gangrene which had set in as a result of his sleeping through a bad lecture. So with the wind whistling past our ears and frozen bodies piling up at our feet, the brave expeditionary force could only express one thought: "Let's just hope that the same squirrelly squad is not in charge of Williams Arena, otherwise the hockey team may find itself in flippers and the basketball squad in Arctic parkas with handwarmers.

ACE'S ADVICE FOR THE MONTH: As Joel C. Harris said, "Watch out w'en youer gittin' all you want. Fattenin' hogs ain't in luck."

CONCLUSION: Answer to the pressing question of the month (Do ice cream cones really have it in for the human race and drip all over our hands on purpose, or are they a commie plot to gum up our slide rules?) The Log's Log expeditionary force of investigators rolled into action. Running into one of our uppers in administration, who was using the indexfinger-thumb method (with the option of the pinky extended) on a chocolate-chip double bon-bon, we asked his noble advice. He commented, "You've got to be careful what you use on your slipstick," or as our token freshman would say, "Slide rule grease works much better!"



discover who you are

...and what you can do.

Explore your talents. Become one of the discoverers in the new Electronic Age. It can all happen at Automatic Electric Company.

Automatic Electric. Largest supplier to the Independent Telephone industry. We are manufacturers of communications products, simple to sophisticated. We sell to industry and to Government as well as to telephone companies here and abroad.

At Automatic Electric your creativity and individuality will receive quick, sure recognition in small project groups. Couple this with the unlimited opportunities that a large company can offer . . . and build a truly challenging future.

The communications industry is growing fast. Why not grow along with us?

We have positions for degreed candidates in these fields:

■ **Electrical Engineering** ■ **Computer Science** ■ **Mathematics**

■ **Industrial Engineering** ■ **Electrical Engineering Technology** ■ **Mechanical Engineering**

SEE YOUR PLACEMENT OFFICE for more information about Automatic Electric Company and Automatic Electric Laboratories. Or, write Mr. Robert J. Diana, Coordinator of College Relations, Automatic Electric Company, 400 North Wolf Road, Northlake, Illinois 60164.

AUTOMATIC ELECTRIC
GENERAL TELEPHONE & ELECTRONICS

An Equal Opportunity Employer

Our 50 year guarantee on clay pipe was ridiculous.

Our new guarantee is twice as ridiculous.

We just raised our 50 year guarantee on the durability of clay pipe to 100 years*. What's so ridiculous about that?

Mainly the fact that guaranteeing clay pipe for any length of time is like guaranteeing the law of gravity. Clay is one of those rare elements in nature that is virtually incapable of being corroded or chemically broken down.

Clay is a residue. It's what is left after sun and rain and sleet and snow have beaten down on the earth for thousands of years. When the earth's crust can't be broken down any further, what you have is clay.

So you can find clay wastewater systems all over the country that have been serving for generations without ever wearing out.

And, we'd like to add that our patented urethane joint makes Dickey coupling pipe the best you can buy. Constant compression, plus flexibility of the plastic material, make certain that a complete bottle-tight seal results throughout the entire joint area. The most dependable and total seal you can get in a wastewater system . . . even if settling occurs.

All of this is why, even though makers of other kinds of pipe never seem to guarantee their product for any specific length of time, we don't hesitate to guarantee ours for 100 years. And that may be the understatement of the century.

W.S. DICKEY *Clay Manufacturing Company*

Kansas City, Missouri; St. Louis, Missouri; Lehigh, Iowa; San Antonio, Texas; Birmingham, Alabama; Meridian, Mississippi; Texarkana, Texas-Arkansas

*Dickey Clay will supply—free of charge—replacements for any clay pipe which has been damaged, destroyed or impaired in service for a period of 100 years from contract date, if damage has been caused by corrosion or other chemical decomposition from acids, alkalis, sewage or industrial wastes (except Hydrofluoric Acid) or damage by rats or other rodents whether pipe is used for industrial, residential or general drainage purposes. Damage from improper handling, placement or trench loading is not covered.

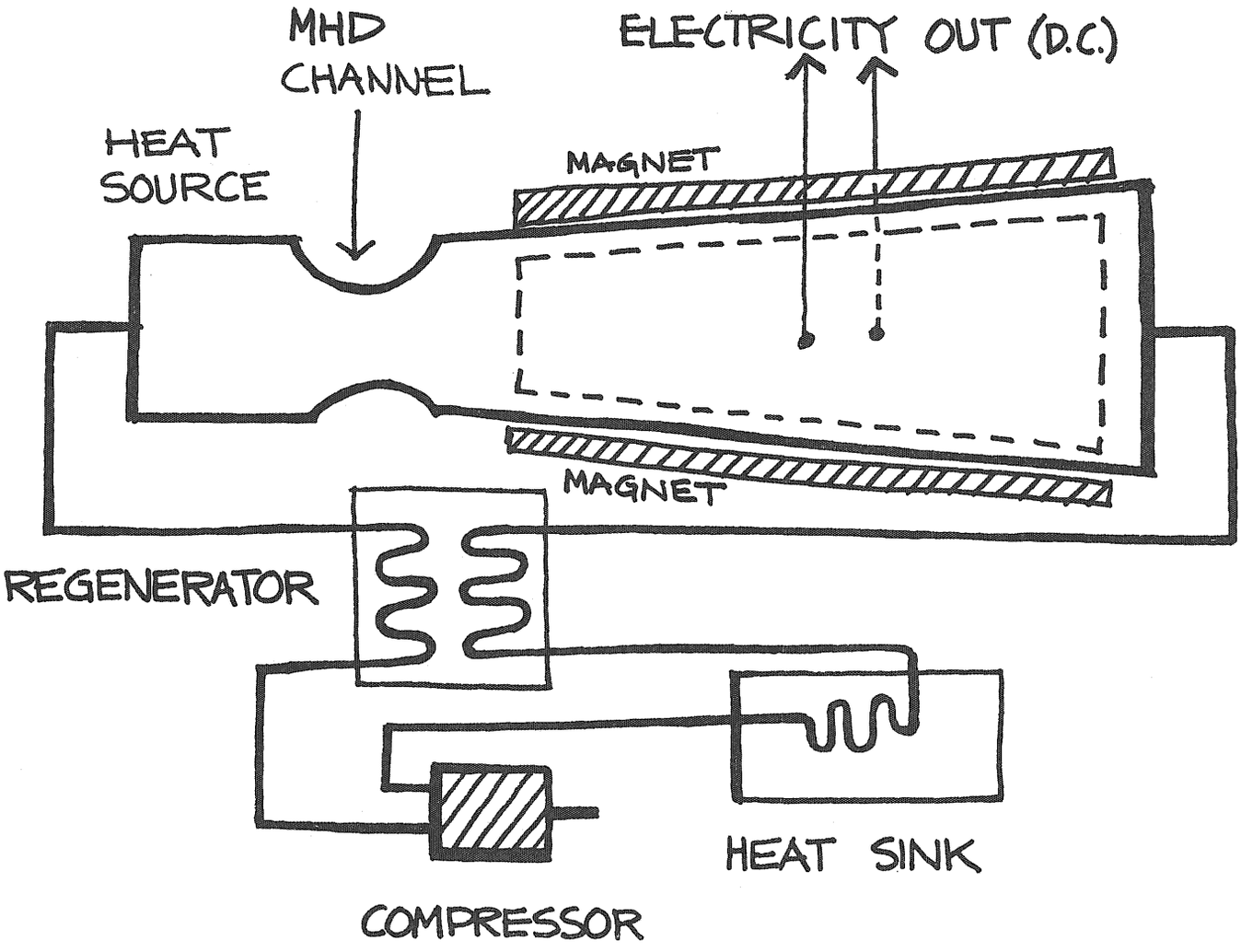


Figure 4. Closed cycle MHD generator.

MHD—*Continued from page 15*

range needs particularly in space application. An MHD engine in tomorrow's spacecraft might operate as shown in Figure 5 with an MHD generator and engine coupled together.

MHD POWER GENERATION

Although MHD engines may play an important role in future technological exploits, it is the MHD generator that is arousing considerable interest among diverse groups.

For the following reasons, the only feasible type of MHD generation in the foreseeable future is an open cycle, coal burning unit. Fossil fuels must be used only with open cycle MHD since exhaust gases cannot be reburned, whereas nuclear heat sources must be used only with closed cycle MHD to avoid radioactive emissions. The nuclear heat source must be eliminated as an alternative since the heat source of an MHD generator must be very hot; much hotter than any reactor core materials can presently withstand.

A further restriction is imposed on the type of fossil fuel used. Natural gas and oil are, in terms of a realistic timetable of MHD development, rapidly vanishing resources. The generator must therefore be designed to use coal, by far the most abundant of the fossil fuels. This leads to many other problems since coal is not a particularly "clean" burning fuel.

A practical MHD power plant must incorporate conventional thermal cycle 'topping" generator in order that improved efficiencies may be achieved. Figure 5 is a simplified illustration of the open cycle MHD generator with steam "topping" cycle.

The operation of this generation system is as follows:

The compressor pressurizes feed air to about six atmospheres, this compressor requires as much as ten per cent of the net generator output to run. The feed air then enters the preheater and it is raised in temperature as high as possible since generator efficiency is directly proportional to the preheated temperature. Next, the preheated air enters the burner along with the coal and ion seed. The seed, such as potassium, is added to produce ions since coal exhaust gas is not ionized. Combustion produces a temperature of four to five thousand degrees. The ionized exhaust gasses are forced out of the burner and into the MHD channel at nearly the speed of sound. The MHD channel is a long (15-20m) tapered tunnel with a powerful magnet (40,000 to 80,000 Gauss) on one radial axis and current collection plates on the perpendicular radial axis. In the channel, the pressure of the gas drops to about 1.5 atmospheres, and the temperature is lowered slightly. The preheater and steam topping

cycle boiler remove much of the remaining heat energy for further electrical energy production.

The electrical power production of the steam topping cycle, which is about 40 per cent efficient, will not be reviewed, since it is the same as most thermal generating units now in operation. In the practical MHD power plant the steam topping cycle supplies 66-85 per cent of the total power output.

Seed recovery and recycling is an economic necessity because the substances used as seed are quite expensive in the quantities required.

A significantly disadvantageous characteristic of the MHD generator is that the power is given off as direct current, and must be converted to 60 cycle alternating current before leaving the plant. Conversion of hundreds of megawatts of direct current at typically 10,000 volts is a considerable task.

EFFICIENCY

The impetus behind all of the research and attention given to MHD is its promise to greatly improve efficiencies in electric power production. Efficiency being the ratio of electrical energy output to input fuel energy.

The efficiency of energy conversion is directly proportional to the expression $\frac{t_1 - t_2}{t_2}$ where t_1 and t_2 are the respective maximum and minimum temperatures of the thermal cycle. The higher the temperature the more efficient the generator.

Modern fossil fuel power plants, operating with combustion temperatures of about 3,000°F, are 38 to 40 per cent efficient, while nuclear plants, whose operating temperature are lower because of reactor core material limitations, are only 33 per cent efficient. Because of the nature of the MHD power plant, combustion temperatures will be 4,000° - 5,000°F. This represents a theoretical efficiency for MHD of up to 70 per cent.

The impact of this fact should be obvious. To the electric utilities it could mean that only about half as much fuel is needed for the same amount of energy produced. To the environmentalist it means that thermal pollution would be substantially reduced, and since less

Continued on Next page

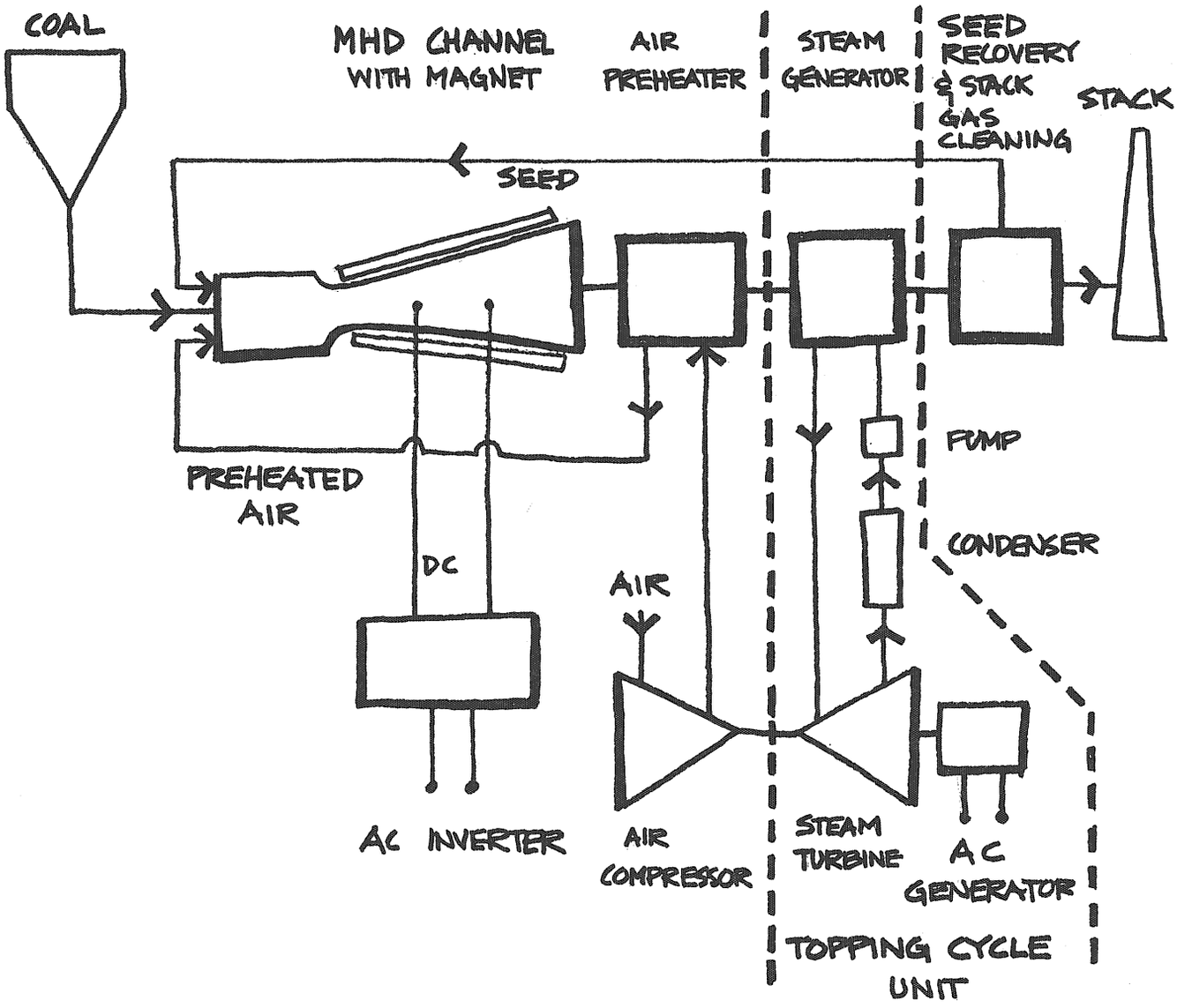


Figure 5. Complete MHD generation system with topping cycle unit.

MHD—*Continued from page 23*
fuel is being burned, obviously less air pollution will result. A closer look at the potential reduction in pollution is now needed.

MHD AND POLLUTION

A recent congressional subcommittee hearing on MHD was entitled Pollution—Free Production of Electrical Energy from Low-Grade Coal—Magnetohydrodynamics. It is not only the environmentalists that believe MHD is pollution free.

Superficially this seems very logical, since the plant is twice as efficient and therefore burning only half as much coal, it should be emitting only half the pollutants. In fact, the higher combustion temperatures may even produce a more efficient combustion and possibly burn away some of the pollutants.

Separately examining each of the major pollutants from power plants could possibly yield a different conclusion.

Waste Heat—The waste heat emitted from the electric power plant is nearly inversely proportional to its efficiency. Therefore thermal pollution would be reduced by as much as efficiency is increased. In fact, MHD could be able to almost eliminate the need for cooling water if the topping unit were an open cycle air turbine. Some sacrifice in efficiency would result, but the waste heat would be emitted directly into the atmosphere.

Ash—The collected ash, which is usually disposed of in land fills would also be reduced proportionally to the increase in efficiency.

Nitrogen Oxides—It is known that nitrogen oxides (NO and NO_2, both pollutants) are more readily formed in higher temperature burners than moderate ones. With the very high temperatures of the MHD burner, several times as much nitrogen oxide will be formed per unit energy than in the conventional burner. No process for nitrogen oxides removal has yet been developed, although such a process would certainly be necessary for MHD operation. If indeed this pollutant could be removed, it would probably be a valuable byproduct.

Sulfur oxides—Sulfur dioxide (SO_2) and sulfur trioxide (SO_3) emissions from coal plants presently are receiving much attention from pollution foes. Usually all of the one to three per cent sulfur in coal is emitted as sulfur oxides, therefore any reduction in fuel would reduce this pollutant proportionally. However, because of its higher temperatures, the MHD plant would produce a somewhat higher percentage of these sulfur oxides as SO_3 than the one to two per cent produced by a conventional plant. This is very undesirable since, as bad as SO_2 is, SO_3 is worse. Sometimes SO_3 will combine with water (H_2O) in the atmosphere and turn into a sulfuric acid mist. Sulfur oxides removal techniques are also as yet undeveloped for large scale need, but may be developed sufficiently by the time MHD appears.

Carbon oxides—Poisonous carbon monoxide (CO) although a minor pollutant in conventional power plants would also be increased because of the intense heat causing disassociation of carbon dioxide (CO_2) into CO and O_2.

A reduction in the volumetric aspect of pollution is reasonably assured, but the increase in the toxicity of the pollutants could be a much greater problem. This is what has been referred to as pollution-free electric power

Page 1

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION
(Act of October 23, 1962: Section 4369, Title 39, United States Code)

Publisher: File two copies of this form with your postmaster. Postmaster: Complete verification on page 2

Form Approved, Budget Bureau No. 46-R029

1. DATE OF FILING: 9/24/70
2. TITLE OF PUBLICATION: Minnesota Technolog
3. FREQUENCY OF ISSUE: Monthly, October through May
4. LOCATION OF KNOWN OFFICE OF PUBLICATION *(Street, city, county, state, ZIP code)*: Rm 2 M E Bldg U of M Minneapolis, Minnesota 55455
5. LOCATION OF THE HEADQUARTERS OR GENERAL BUSINESS OFFICES OF THE PUBLISHERS *(Not printers)*: Same
6. NAMES AND ADDRESSES OF PUBLISHER, EDITOR, AND MANAGING EDITOR
   PUBLISHER *(Name and address)*: Minnesota Technolog Board Rm 2 Mech Eng Bldg
   EDITOR *(Name and address)*: Marvin G. Vikla & Frank A. Collins
   MANAGING EDITOR *(Name and address)*:
7. OWNER *(If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual must be given.)*

NAME	ADDRESS
University of Minnesota Technical Association	Rm 2 M.E. Bldg. University of Minn Minneapolis, Minn. 55455

8. KNOWN BONDHOLDERS, MORTGAGEES, AND OTHER SECURITY HOLDERS OWNING OR HOLDING 1 PERCENT OR MORE OF TOTAL AMOUNT OF BONDS, MORTGAGES OR OTHER SECURITIES *(If there are none, so state)*

NAME	ADDRESS
None	

9. FOR COMPLETION BY NONPROFIT ORGANIZATIONS AUTHORIZED TO MAIL AT SPECIAL RATES *(Section 132.122, Postal Manual)* *(Check one)*

The purpose, function, and nonprofit status of this organization and the exempt status for Federal income tax purposes: ☑ Have not changed during preceding 12 months ☐ Have changed during preceding 12 months *(If changed, publisher must submit explanation of change with this statement.)*

10. EXTENT AND NATURE OF CIRCULATION	AVERAGE NO. COPIES EACH ISSUE DURING PRECEDING 12 MONTHS	ACTUAL NUMBER OF COPIES OF SINGLE ISSUE PUBLISHED NEAREST TO FILING DATE
A. TOTAL NO. COPIES PRINTED *(Net Press Run)*	2500	2500
B. PAID CIRCULATION 1. SALES THROUGH DEALERS AND CARRIERS, STREET VENDORS AND COUNTER SALES	2140	2140
2. MAIL SUBSCRIPTIONS	10	10
C. TOTAL PAID CIRCULATION	2150	2150
D. FREE DISTRIBUTION *(including samples)* BY MAIL, CARRIER OR OTHER MEANS	150	150
E. TOTAL DISTRIBUTION *(Sum of C and D)*	2300	2300
F. OFFICE USE, LEFT-OVER, UNACCOUNTED, SPOILED AFTER PRINTING	200	200
G. TOTAL *(Sum of E & F—should equal net press run shown in A)*	2500	2500

I certify that the statements made by me above are correct and complete. ▶ *(Signature of editor, publisher, business manager, or owner)*: JoAnn Hanson

POD Form 3526, May 1968

generation; not to mention that the MHD plant would probably be three times as large as the current plants thereby concentrating the pollution.

What finally must be considered is the possibility of achieving the 70 per cent theoretical efficiency figure quoted by serious MHD proponents. Many calculations from current MHD research show that reasonable MHD plant efficiencies (with the conventional steam topping unit) possibly range from 42-55 per cent. By subtracting the steam topping cycle contribution to the efficiency shows that the net increase in output efficiency due to the MHD addition is about 5-20 per cent.

MHD RESEARCH AND DEVELOPMENT

In several of the more industrialized countries of the world, thorough investigation of MHD generation has been underway for a number of years. Both Japan and the Soviet Union are presently building large experimental MHD prototypes. The Soviet Union's generator will be a natural gas fired, 25 megawatt unit. The British and French have both terminated their MHD research programs. They had hoped that practical MHD could be developed sooner than was found possible. Germany, unlike most other countries, is concentrating its efforts on closed cycle MHD systems.

In the United States, the electric power industry is at the crossroads of a decision whether or not to continue MHD research and development. Over the past 5 to 10 years, some $10 million have been used to support MHD research at AVCO Everett Research Laboratories, Everett, Mass. AVCO has built and tested components of MHD generators through the sponsorship of the Edison Electric Institute, a nationwide association of electric power utilities, and various branches of the government.

PROBLEMS

Major unsolved problems are presently blocking MHD's way to success. Can heat exchangers (or preheater) be developed to deliver the preheated air at the temperatures needed? Can materials be devlopd to withstand the caustic effects of the high temperature MHD burner? Can the problem of working with polluting coal exhaust gas be solved? Can a complex system of MHD and topping cycle be made to operate dependably?

All of this boils down into one question which is now being considered by the power companies. Should the effort be made to develop MHD? If the answer is yes, an estimated 30 years, and at least $100 million would be required to do the job. If development were undertaken, MHD still would not represent a significant portion of the power generating capacity until after the year 2,000, or about the time controlled thermonuclear fusion power generation is predicted to be developed. When both are developed thermonuclear fusion is expected to be very safe and much more efficient than MHD at that time.

If, however, development of MHD generation goes as well as some expect, and pollution control equipment is developed on time, this generator might have a great deal to do with extending the life of our limited fossil fuel reserves, as well as safeguarding the environment.

If you want a study break
and experience, then try

Minnesota's Co-op Program

The Cooperative Engineering Intern Program provides practical engineering experience during the junior and senior years of a student's university career

What is the Cooperative Engineering Intern Program (EIP or COOP Program), and who is the "right" person to apply for it? This is probably one of the many questions that need answering for the new engineering student.

The COOP Program provides practical engineering experience during the junior and senior years of a student's university career. It allows the student to work with a company and gain valuable training while completing his academic requirements in a system of alternating quarters. The EIP Program is administered by the Mechanical Engineering Department for the benefit of the Mechanical and Industrial Engineering students at the University of Minnesota.

Another question that might come up now is, "What advantages does this program have over going straight through and finishing your schooling without interruption?" The benefits are many, but the principle ones are the valuable knowledge gained by practical application of your engineering training, and the financial support received for your academic studies, since you are paid as a productive member of a commercial engineering team while you are working. Also, there is a less recognized, but equally as important reason for considering the EIP Program. "How much do you really know about engineering positions in industry?" Sure, you are doing all right sitting in class for five hours a day and finishing your homework, but you certainly must realize engineering in industry is nothing like attending engineering school. It may end up that you do not even like being a working engineer, and the majority of four years of study cannot be directly applied to any other type of occupation. Well, the EIP Program gives you a chance to experience engineering as you would after graduation, but with the option of changing to a more suitable field before it is too late.

Participating students enter the program as juniors following the completion of the first two years of the required engineering curriculum. The total number of COOP students are divided so that approximately 50 percent are placed on industrial assignments and the other 50 percent are placed on academic assignments for a particular quarter. The program is on a four-quarter per year basis with the two summer sessions comprising one quarter.

A formal technical report is required from each student registered for an industrial assignment. The student receives two, technical elective credits for the comprehensive report. It is also suggested that the student take a three credit course in an approved non-technical area from the Extension Divsion or by correspondence. The earliest possible graduation date for participating students is at the end of the second summer session instead of the normal June graduation date.

Entrance requirements for students desiring to apply are a grade point average of 2.0 (C) or better and eligibility for admission to upper division. Once the entrance requirements are met the student may start application procedures.

The following steps must be completed by January 1st of the current year in order to be accepted into the program in June.

1. Submit an application blank which may be obtained from the EIP Program Office upon request.
2. Submit a transcript of grades through the most recent (fall) with the application.
3. Submit a company preference card. Select six companies in order of your preference with whom you desire to work from the list of companies. The order of preference may be changed following company interviews. If you require assistance in making the selection, your college advisor may be able to help you.
4. You should be willing to accept either a summer or fall quarter industrial assignment. Companies generally prefer one student working while the second student is on academic assignment.

About March 1st applicants will be notified if they have been accepted for the program. Half-hour interviews will then be scheduled for the Spring Quarter Break or on a Monday, Tuesday or Wednesday in March with the companies previously selected. After the interviews, a card stating final company preferences along with a fairly recent photograph should be submitted to the EIP Program office.

About May 1st the EIP Program Office will notify applicants as to their company assignments, specific work quarter, and some additional instructions. Students are not definitely in the program until they have been assigned to a company.

Of course, a program of this nature is not without some disadvantages. Among them is the constant need for adjustment from working to studying and back again several times. Another possible disadvantage is the location of the company. In some cases a new residence will be needed for three-month intervals or if the company is in the area transportation to and from work may pose a problem. But, comparing the disadvantages to the benefits, the real program merits are evident. List of program objectives include:

1. First hand knowledge of, and experience with the execution in industry of engineering design, development, research, production, quality control, etc.
2. Aid the student in financing the last two years of his education. About $6,500 to $7,500 for two years.
3. Give understanding of, and familiarity with, the problems and viewpoints of people in industry.
4. Assist students by direct and personal experience in industry and to test their aptitude for engineering careers.
5. Enable engineering students to adjust themselves to engineering employment by gradual and easy transitions from academic pursuits.
6. Train and otherwise prepare students especially for the administrative and operating functions of an engineering career.

The program may sound entirely one sided to the advantage of the student, but it is not. Participating companies get a person that they expect to be a competent worker and that will aid their production. Also, the companies are making contacts for possible sources of engineers that could fill their future needs.

Professor C. E. Lund is the current director of the EIP Program. All materials for application and procedural instructions can be obtained from the EIP Program Office of the Mechanical Engineering Department.

Participating Companies as of June 1970

Minnesota companies

Boise Cascade, International Falls
Continental Machines, Savage
Conwed Corporation, Cloquet
Donaldson Company, Minneapolis
FMC Corporation, Minneapolis
Graco, Minneapolis
Hobart—Federal Engineering, Minneapolis
Honeywell, Inc., Minneapolis
International Business Machines, Rochester
McQuay, Inc., Minneapolis
Minnesota Mining and Manufacturing, St. Paul
Northern States Power, Minneapolis
Northern Malleable Iron, St. Paul
Northwest Paper Company, Cloquet
Pillsbury Company, Minneapolis
Reserve Mining Company, Silver Bay
Rosemount Engineering Company, Minneapolis
Texaco, Inc., Minneapolis
Thermo King Corporation, Minneapolis
Toro Manufacturing, Minneapolis
University of Minnesota, Plant Services, Minneapolis
Whirlpool Corporation, St. Paul

Out of State companies

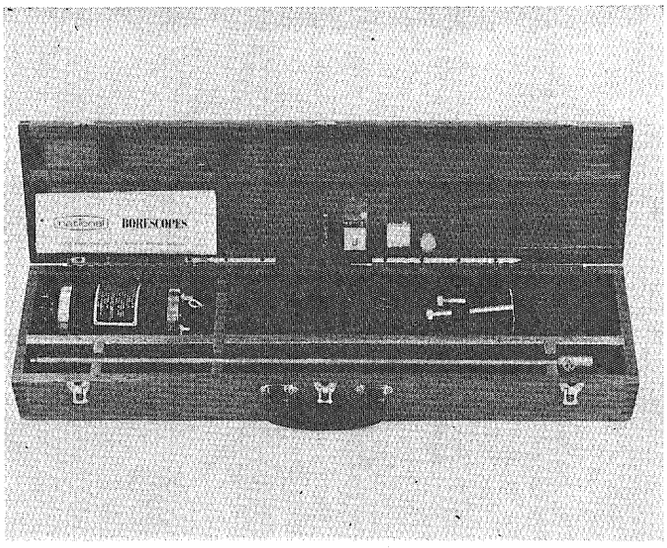
Arnold Research, Arnold Air Force Base, Tennessee
Caterpillar Tractor Company, Peoria, Illinois
Cleveland-Cliffs Iron Company, Ishpeming, Michigan
Collins Radio Company, Cedar Rapids, Iowa
Cutler-Hammer, Milwaukee, Wisconsin
Deere and Company, Moline, Illinois
Falk Corporation, Milwaukee, Wisconsin
General Motors Proving Ground, Milford, Michigan
Pontiac Motor Division, Pontiac, Michigan

What's New

...in Science and Engineering

Borescopes

National Borescopes permit close visual inspection of internal or remote surfaces and cavities. These versatile instruments have proven particularly valuable for making visual checks of internal welds and joints, pipes, internal



threads, and chambers, and for examining the interior of engines. The instant checking of a malfunctioning component is possible because the unit need not be dismantled for inspection. Borescopes are ideal for aircraft inspection procedures, including the inspection of internal wing surfaces, examining wiring and fuel lines, and checking condition of vanes in jet engines and compressors.

Pollution and Noise Control

The first Washington bus equipped with an experimental modification for reducing smoke, odor, noise and emissions was put in service this month in a joint project by the Department of Transportation and General Motors. The Washington bus is outfitted with GMC Truck & Coach Division's "Environmental Improvement Program" (EIP) designed to diminish smoke and objectionable odor to below the level of visibility under most operating conditions and to substantially reduce emissions.

In before and after tests with the D.C. Transit bus, EIP reduced hydrocarbons up to 96 per cent, carbon monoxide up to 64 per cent, and nitrogen oxides up to 23 per cent. Interior noise levels were reduced up to 20 per cent from the EIP installation.

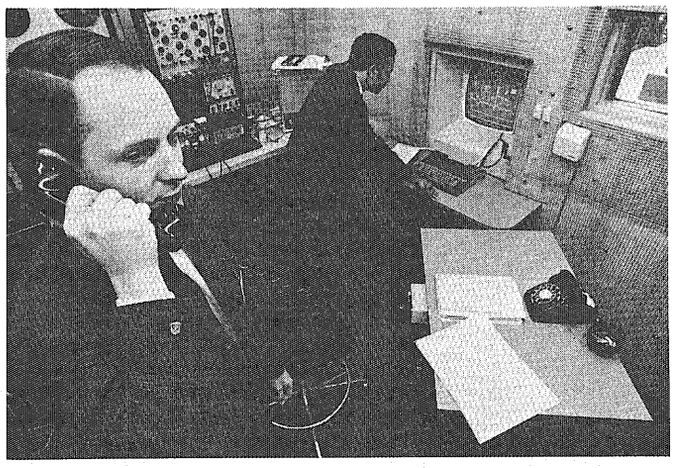
EIP is limited to post-1959 buses since their body design and engine installations provide adequate engine compartment room for the modification. There are more than 22,000 buses of this type in service today, about 45 per cent of the nation's transit and suburban bus population.

A cleaner exhaust is dispersed above the bus through a vertical exhaust system instead of at street level. Another major EIP component is an improved needle valve fuel injector for reducing emissions and smoke by precisely metering fuel directly into the cylinder for better combustion. EIP's exhaust muffler reactor primarily diminishes objectionable exhaust odor and improves engine efficiency, while rubberized engine cradle mountings significantly aid in reducing engine noise.

Estimated cost of EIP components is $1,100 for a V6 diesel and about $1,200 for a V8 version, plus taxes and installation.

Voice Recognition

At the Systems Development Division Speech Processing Technology Department of its Research Triangle Park, N. C., laboratory, IBM is exploring the possibility of using speech patterns to verify personal identity; they also are developing several experimental systems to process speech in other ways. IBM already has machines which give the computer a "voice" to compose messages from recorded human speech stored in the system. Now an experimental system is being developed to produce synthetic speech in place of human speech. There are



two goals of the work in this field: to translate **what** is said by the speaker into machine-readable form, and to verify **who** is speaking.

Recently, Drs. Monn and Das gave a progress report on their development of a speaker verification system which converts the patterns of a spoken phrase into a set of 200 numbers. Each number represents a measurement taken on a particular characteristic of a person's speech.

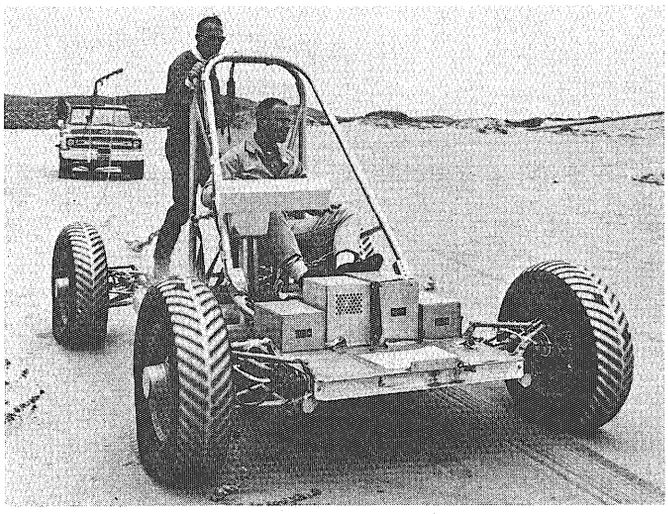
Generally, these characteristics include not only such simple categories as pitch and amplitude of sound waves, but also the amounts of energy of the speech pattern over certain ranges of both frequency and time; and also phenomena called "formants," which are peaks in the speech pattern. These measurements give a good profile of a particular speaker and are intended to be difficult to imitate.

Here's how the system works. After the system has computed the 200 values for a spoken phrase, it compares them with a similar series calculated earlier from utterances of the same phrase by the individual the speaker claims to be. If the two records are sufficiently similar, the system gives a "yes" verdict; if they're different, it says "no." In a completed experiment, the one imposter who fooled the system the most had a voice so similar to one real speaker that a linguist who heard both voices from tape recordings thought they were one and the same speaker.

For the present new applications for conversational speech processing systems are being considered. Because it is such a natural form of communication for man, the prospects of extending the use of computer power to more people through the use of speech are very exciting.

Moon Buggie Design

Astronauts are conducting a Lunar Rover mobility test unit near Pismo Beach, California. The vehicle was built by the AC Electronics Division of General Motors



Corporation, major subcontractor to the Boeing Company for the development of the Rover's mobility systems. Boeing is building four Lunar Roving Vehicles to transport astronauts on the moon. The mobility unit is being used to determine Lunar Rover performance capabilities and to prove the design concept of a one "G", or Earth-weight Lunar Rover which will be used for astronaut training. For these tests power is supplied from a truck through an umbilical connection. Each of the four flight versions will be powered by batteries carried aboard the vehicles.

Burroughs B7700

The B7700—the most advanced, largest and most powerful of Burroughs 700 Systems family—is a very fast parallel processing system with exceptional versatility in configuration. These can be combined in a variety of ways in tailoring the system to the user's exact needs. It is fully code compatible with the new B6700.

The system's performance and its adaptability to high

volume data communications and very large data base environments results from its advanced architecture in which independent computing, memory and input/output elements interact through an electronic grid called a central exchange. The B7700 central exchange accomodates up to eight memory subsystems and a combination of up to eight central processors or input/output processors. In B7700 systems, the central exchange permits independent communication between memory modules, central processors and input/output processors. Multiple read/write/compute operations occur simultaneously.

The very large scale B7700 will be ready for delivery in early 1972. A functioning design test model is shown.

Splinters

by Barry Johansen and Ralph Polkinghorne

—vilitas et crudas semper ternam

Overheard on the West Bank:
Narc, narc,
Who's there?
J. Edgar Hoover.
Oh, oh.

• • •

Two Mexicans were driving to town and the following conversation ensued:
"Hey, I tink you keel a kitty-cat."
"Why you say that?"
"I hear meow-meow under the car."
A little while later:
"Hey, I tink you keel a puppy-dog."
"Why you say that?"
"I hear bow-wow under the car."
And still later:
"Hey, I tink you keel a man from Florida."
"Why you say that?"
"Someone yell sunny beaches under the car!"

• • •

Also overheard on the West Bank:
Give me librium or give me meth!

• • •

Fashion note from Paris: Girls will be wearing the same thing in bras this year as last.

• • •

Pity the poor little ash in the virgin timber. She was defoliated without being axed, by a son of a beech.

• • •

What's the German word for bra?
Der Holdemfromflopin!

• • •

Do you know what an elephant does on the highway?
About three m.p.h.!

When the explorer asked the Alaskan what he must do to prove himself a man, the native told him, "You must drink a full bottle of whiskey, kill a bear with your knife, and make love to an Eskimo woman." Deciding to try it, the explorer downed a bottle of whiskey, and ran off into the woods. The next morning the explorer came staggering into camp all cut up and bloody, yelling, "Now, where's that Eskimo I gotta kill?"

• • •

Chem E. "Did you ever sleep with my girl?"
Aero E. "Not a wink!"

• • •

Q. Do you know the difference between rape and rapture?
A. Salesmanship.

• • •

Chemical Description of Woman
Symbol: Wo
Atomic Weight: 120
Physical properties: Found wherever man is found. Generally rounded in form. Boils at nothing and may freeze at any time. Melts when treated properly. Turns bitter when not used properly.
Chemical properties: Very active. Possesses affinity for gold, silver, platinum and precious stones. Violent when left alone. Able to absorb great amounts of food. Turns green when placed beside better looking specimen. Ages rapidly.
Uses: Highly ornamental. Catalyzes the disintegration of wealth. Is probably the most powerful income reducing agent known.
CAUTION: Highly explosive when in inexperienced hands.

It's wonderful when you're married. In fact, it's wonderful even when you're not!

• • •

What's black and white and climbs the walls?
A female penguin in heat.

• • •

What goes "Mark, Mark"?
A harelip dog.

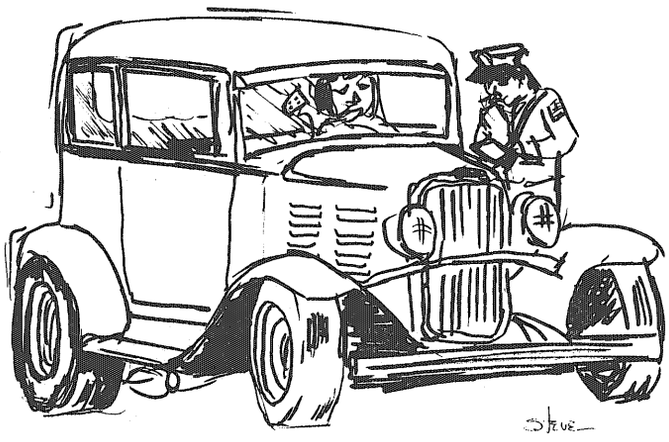
Forester: "Say, what ya eating?"
Ag. E.: "Turtle soup."
Forester: "How did ya get it out of his shell?"
Ag. E.: "Took it to an analyst."

• • •

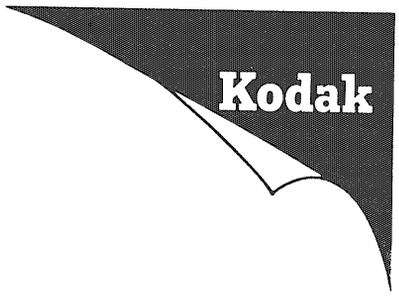
The Minnesota Daily

• • •

Chem E. "What do you get if you throw a sparrow in an electric fan?"
EE. "Shredded tweet?"



But officer, speed is only relevant.



Hard times come and go.

We still hunt chemical engineers.

Also mechanical and industrial engineers.

In Rochester, N. Y., in Kingsport, Tenn., in Longview, Tex., in Columbia, S.C., our plants will soon be providing holders of 1971 baccalaureates in chemical engineering with plenty of opportunity to practice what has been preached at them. Great!

Some current Ch.E. seniors, however, may have begun to suspect that before another autumn rolls around, with diploma safely in hand, they will have had enough of chemical engineering as understood on campus.

Let these not be ashamed. Aside from stimulating opportunities in the kind of marketing that demands a chemical engineer, we offer them **other worthy alternatives.**

Recruiters may prove a little scarcer this year than in years gone by, but *our* campus visitors are on the prowl and eager to explain in what respects *our* conception of work calling for a chemical engineering degree extends farther than usual.

If interested, tell your Placement Office or drop a note to

EASTMAN KODAK COMPANY
Business and Technical Personnel
Rochester, N.Y. 14650

An equal-opportunity employer.

An engineer can cut crime as well as any cop. Maybe better.

Last year, murder was up 7%. Rape was up 17%. Robbery was up 14%.

It's getting to the point where a woman can't show her face on a dark street. And grown men are running scared. Sadly, crime has become a part of our everyday lives.

Where do we turn for help? To police, of course. But why not also to engineers?

Engineers at General Electric set out to develop a more efficient streetlight. And they came up with one of the most efficient crime fighters ever invented.

It's called the Lucalox® lamp. It puts twice as much light on a street as any other lamp without any extra operating cost. And wherever Lucalox has gone up, crime has gone down. By 50% or more in city after city.

But that's not all an engineer can do. He might design communications equipment that enables one patrolman to do the job of two. Or a complex of traffic monitors that puts twenty cops back on the beat. Or even a patrol car to do its special jobs in a better way.

It's sometimes hard for people to realize that engineers, with their technology, can solve social problems. But, in fact, some social problems can't be solved any other way.

So if you're an engineer who's bothered by social problems, you're in a unique position to help.

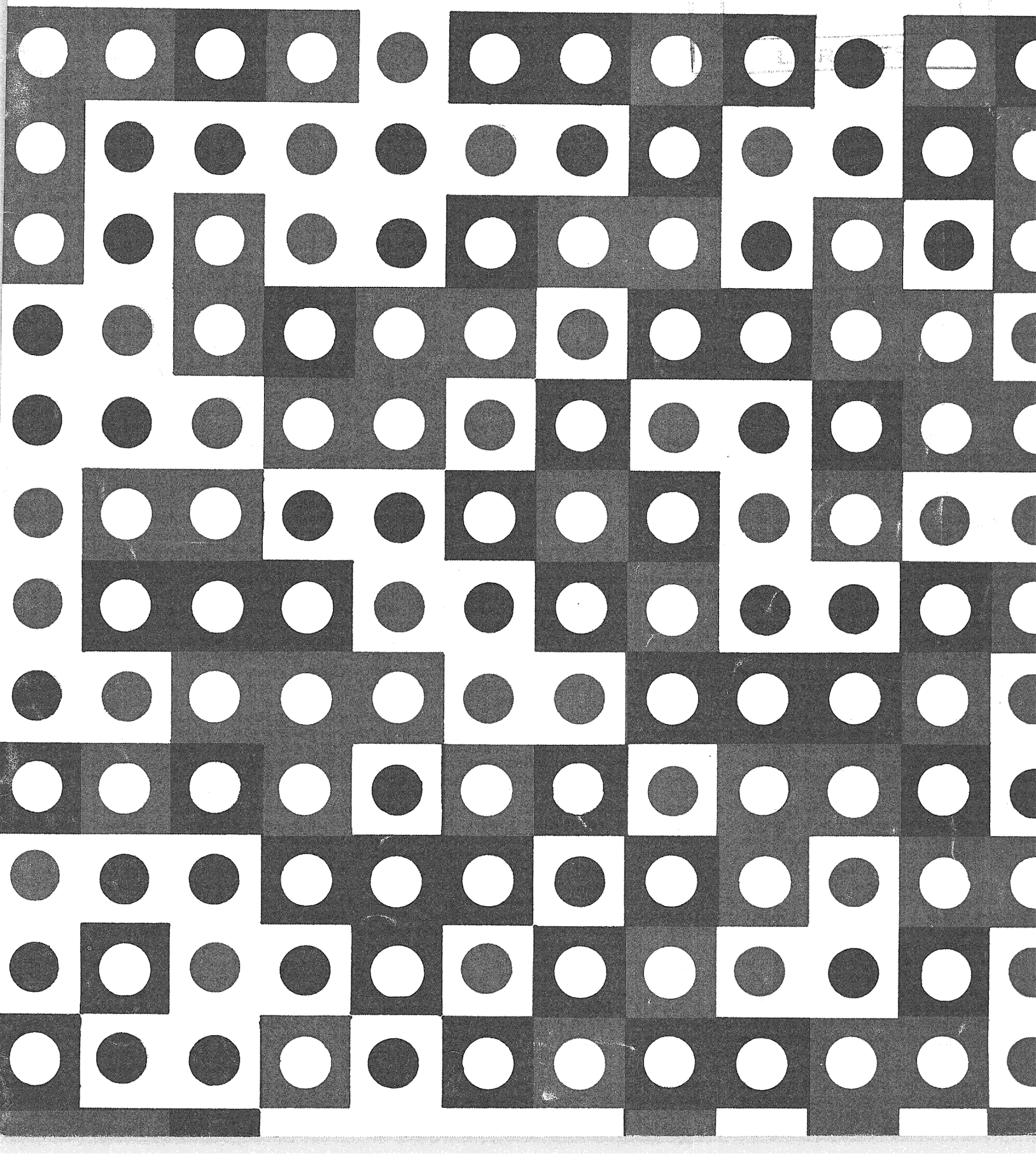
General Electric could use your help. We see more problems around us than we know how to solve. So what we need is more engineers.

GENERAL ELECTRIC

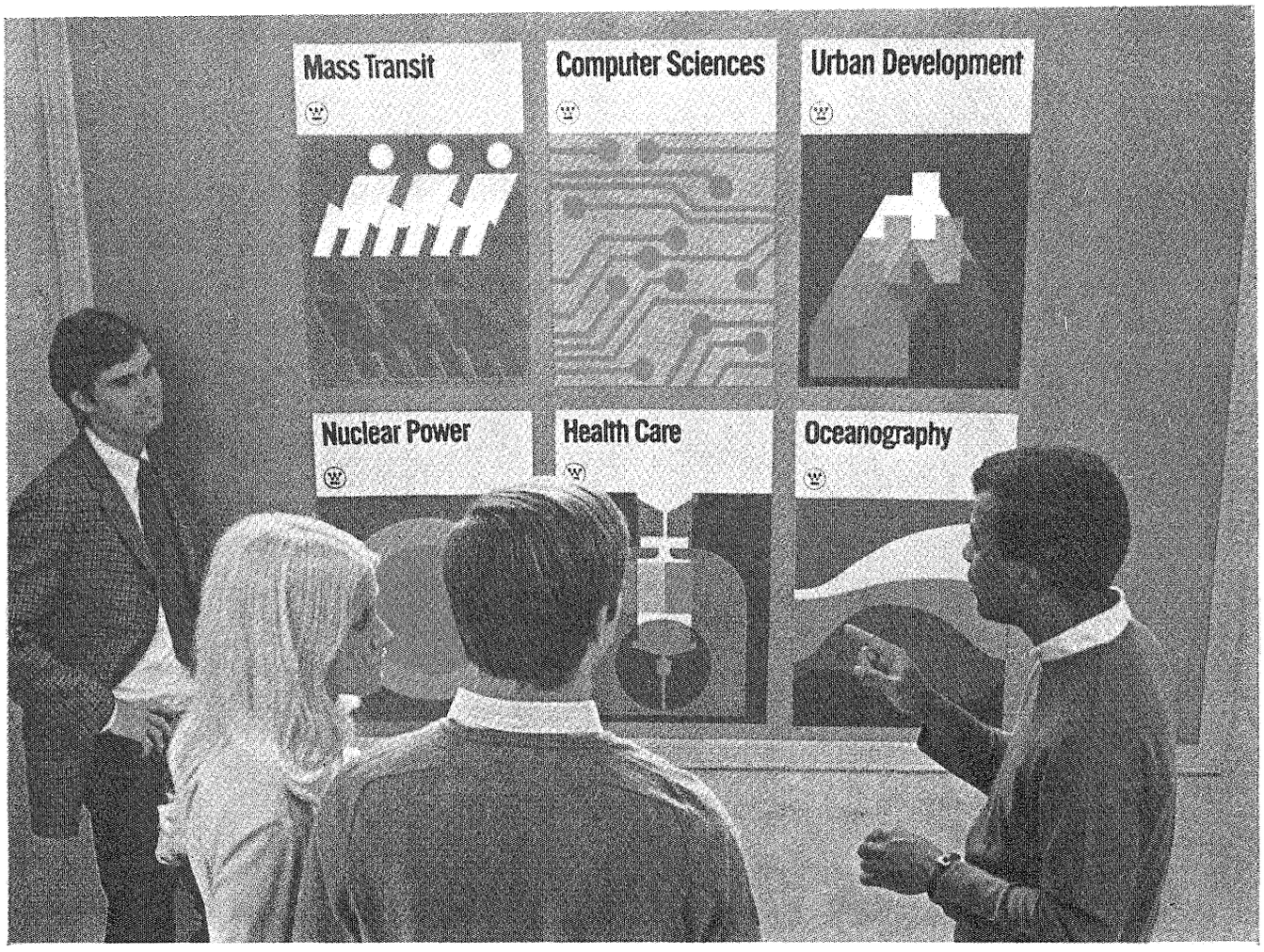
An equal opportunity employer

TECHNOLOG

UNIVERSITY OF MINNESOTA DECEMBER, 1970



If you want to engineer a better world...



a great place to start is with one of the most diversified companies in the world.

Westinghouse thinks its responsibilities are as big as its capabilities—and that's big.

And when you're in everything from computers to urban development, to medical science, to mass transit, to oceanography—there's action. For example...

Transportation: Our computerized transit systems can operate on a 90-second schedule, and meet the transportation needs of many cities.

Urban Development: Our new construction concepts will provide better communities across the country. Projects are planned or underway in 30 major cities.

Health Care: We are using a systems approach to provide better medical care for more people. Example: electronic equipment that lets nurses monitor the hearts of eight patients simultaneously.

Nuclear Power: Westinghouse leads the way in nuclear power generation. Seven nuclear plants in operation, 34 in various stages of design. We're working on a breeder reactor to keep us ahead.

That's a sampling. We're just getting started. If you'd like to help us engineer a better world, talk with our campus recruiter. Or write Luke Noggle, Westinghouse Education Center, Pittsburgh, Pa. 15221. An equal opportunity employer.

You can be sure...if it's Westinghouse

Venture: Seven minutes to save a life.

The problem: lifesaving clinical tests of blood, urine and spinal fluid may take technicians hours to perform using traditional methods.

The possible solution: design a virtually complete chemical laboratory in a desk-sized cabinet that will perform a variety of clinical tests automatically, accurately, quickly.

The result: Du Pont's Automatic Clinical Analyzer, the end-product of years of cooperation and problem solving among engineering physicists, biochemists, electromechanical designers, computer specialists and many, many others.

The heart of the instrument is a transparent, postcard-sized reagent packet that functions as a reaction chamber and optical cell for a computer-controlled analysis of specimens.

Separate packs—made of a chemically inert, optically clear plastic—are designed for a variety of tests. And each pack is supplied with a binary code to instruct the analyzer. Packs for certain tests also contain individual disposable chromatographic columns to isolate specific constituents or molecular weight fractions on the sample.

In operation, the analyzer automatically injects the sample and diluent into each pack, mixes the reagents, waits a preset time for the reaction, then forms a precise optical cell within the walls of the transparent pack and measures the reaction photometrically.

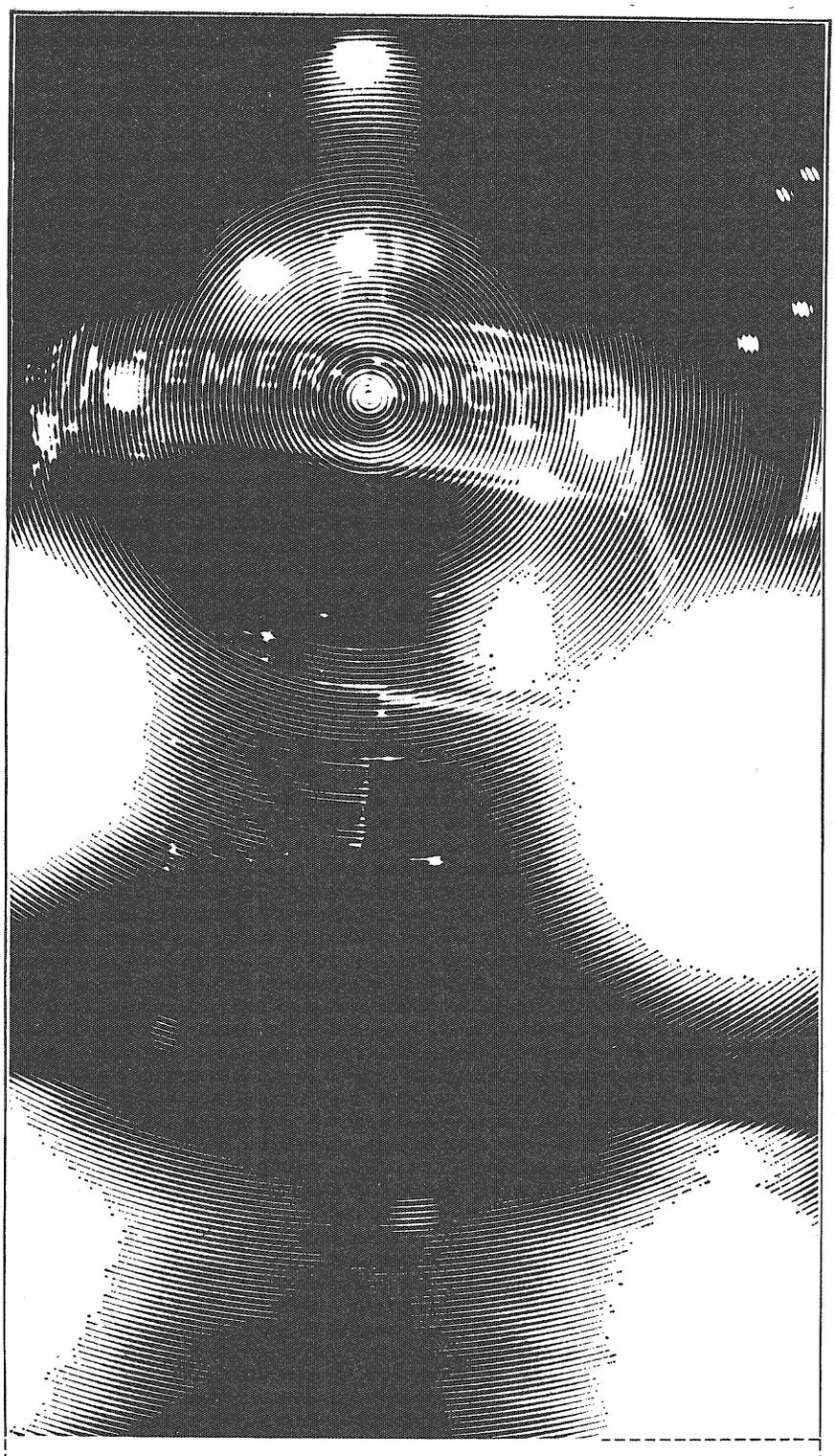
A built-in solid-state computer monitors the operation, calculates the concentration value for each test and prints out a report sheet for each sample. The instrument is capable of handling 30 different tests, the chemistry procedures for ten of which have already been developed. The first test result is ready in about seven minutes. And in continuous operation, successive test results are obtained every 35 to 70 seconds, depending on the type of test.

Innovation—applying the known to discover the unknown, inventing new materials and putting them to work, using research and engineering to create the ideas and products of the future—this is the venture Du Pont people are engaged in.

For a variety of career opportunities, and a chance to advance through many fields, talk to your Du Pont Recruiter. Or send the coupon.

DU PONT
REG. U.S. PAT. OFF.

Ventures for better living.



Du Pont Company, Room 7894, Wilmington, DE 19898

Please send me the booklets checked below.

- ☐ Chemical Engineers at Du Pont
- ☐ Mechanical Engineers at Du Pont
- ☐ Engineers at Du Pont
- ☐ Accounting, Data Systems, Marketing, Production

Name_____

University_____

Degree_____ Graduation Date_____

Address_____

City_____ State_____ Zip_____

An Equal Opportunity Employer (M/F)

TECHNOLOG

VOL. 51, NO. 3 — Official Student Publication of the Institute of Technology, University of Minnesota — DECEMBER 1970

FEATURES

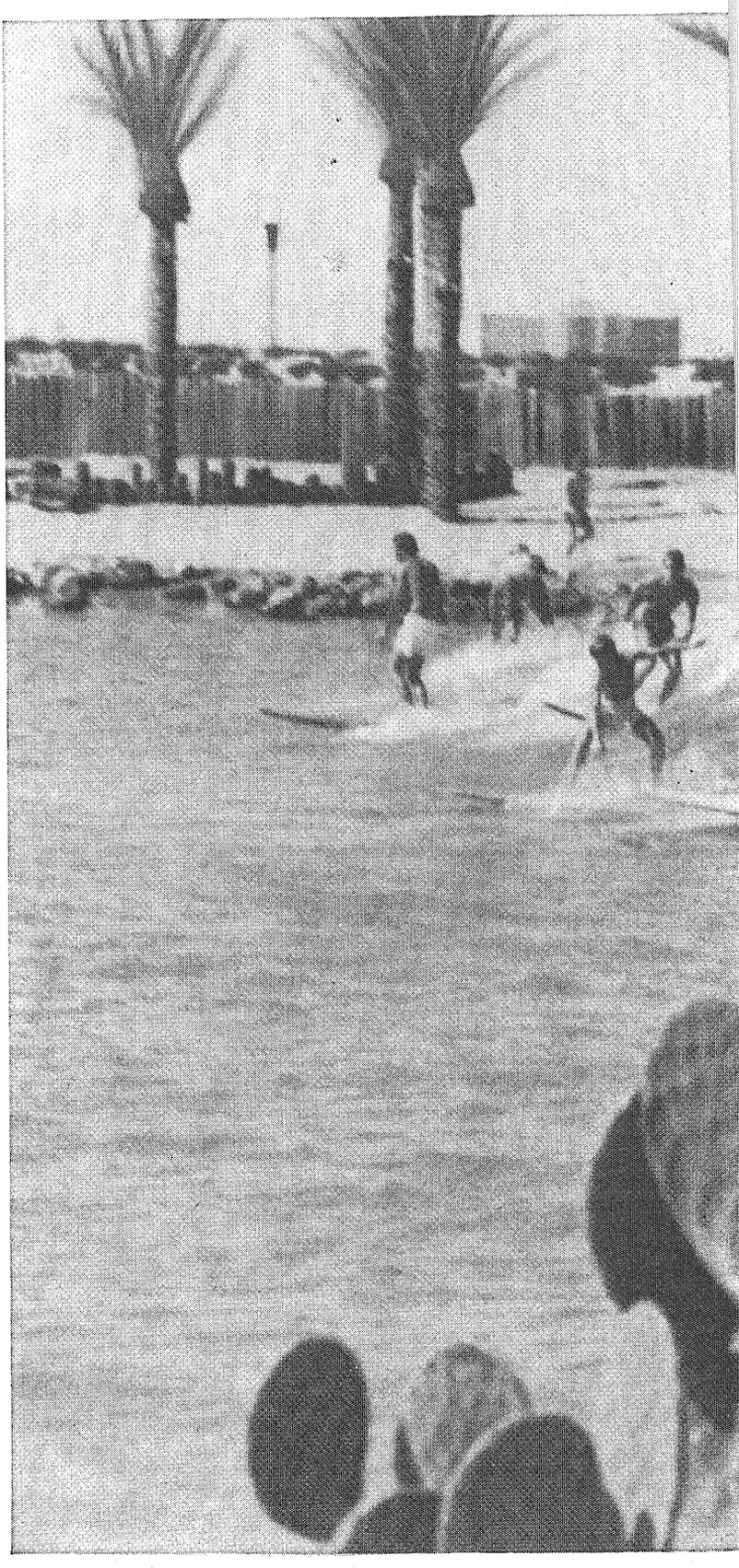
DEPARTMENTS

ABOUT THE COVER: THE DESIGN REFLECTS THE PATTERN FOUND ON THE CIRCUIT BOARD OF AN ANALOG COMPUTER. THE PATTERN IS ENTIRELY RANDOM. DESIGNED BY BRUCE WRIGHT.

MEMBER OF ECMA

Published monthly, October through May. Second-class postage paid at Minneapolis, Minnesota. Office: Room 2, Mechanical Engineering Building, University of Minnesota, Minneapolis, Minnesota 55455. Telephone: 373-3298. Printer: Bruce Publishing Co., 2642 University Avenue, Saint Paul, Minnesota 55114. Publisher's National Representative: Littell-Murray-Barnhill, Inc., 369 Lexington Avenue, New York, New York 10017 and 737 North Michigan Avenue, Chicago, Illinois 60611. Publisher's State and Local Representative: University Engineering Magazine Advertising, F. P. McGrath Manager, Box 14026 University Station, Minneapolis, Minnesota. Telephone 612-225-0708. Member of the Engineering College Magazines Associated, Gordon Smith, Oklahoma State University, Stillwater, Oklahoma. Subscription rate: $3.00 per year, single copies 50 cents. Advertising rates upon request. Any opinions expressed herein are not necessarily those of the Institute of Technology or of the University of Minnesota.

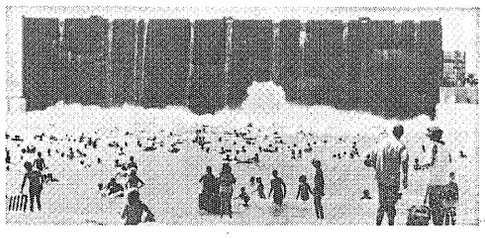
They're "shooting the curl" in Phoenix.



Surfing has come at last to the Arizona desert.

The ersatz ocean is called Big Surf*. At 4 million gallons, it's believed to be the biggest "pool" ever built: 400 feet long by 300 feet wide, and nine feet at its deepest point.

And it makes its own waves.



Every 60 seconds, the crashing surf propels an army of Arizona's finest toward a sandy 4½ acre beach.

Now about the waves. They're made by pumping water into a 160 foot by 41 foot tank-like "reservoir." Up to 100,000 gallons are released through 15 gates at the reservoir base. The water passes over a custom concrete "reef," and is formed into a wave up to five feet high.

The restless sea is kept restless by three 250 hp Peerless mixed flow pumps from FMC Corporation. They are the same pumps that irrigate deserts in the Middle East, provide flood control in Louisiana, and fill city reservoirs in New York.

And FMC is the same company that makes fibers, food machinery, railroad cars, industrial chemicals, and a whole lot of other things you never hear about because we work behind the scenes.

If you'd like to do something about making waves in the desert, or fighting famine in India, or anything else that a diversified company does to improve life, pick up a copy of our brochure "Careers with FMC" from your placement office. Or write FMC Corporation, Box 760, San Jose, Calif. We're an equal opportunity employer.

fmc CORPORATION ®

FMC CORPORATION

Putting ideas to work to make water more fun

Logline

Conference

The University of Illinois hosted the third annual Upper Midwest Engineering Council Conference Nov. 6-7. In attendance were delegates from 12 of the major engineering schools in the area. University of Minnesota was represented by five student members of the Tech Commission, IT's engineering council, sent with the financial assistance of the IT Alumni Association. The purpose of the conference was to promote an exchange of ideas and thoughts concerning our individual council's activities, and learn how we might better serve the community which we represent.

From almost all councils came reports of similar problems: poor communication with the student body, difficulties in getting students to work on council activities, lack of faculty and administration cooperation, bureaucratic council structures, necessary curriculum reform, and inadequate rapport with the rest of the university community. These reports brought forth a variety of solutions.

To foster better communication in all areas, some councils sponsor student-faculty social gathering, and Northwestern University's council has opened its membership to anyone who attends three consecutive meetings.

On the subject of curriculum reform, it was felt that the University of Minnesota was a forerunner among the schools represented. The provisions of IT's Education of Engineer report were discussed in length at many of the sessions. Each council was also provided with a copy of the report.

The role of the engineering council in the environmental movement was also discussed. While most councils admitted being passively involved, some have been very active in providing information and services for those seeking to become involved. It was suggested that each council encourage the development of ecological curriculums at their institution, and make a special effort to inform students of these types of courses.

Much disparity was apparent in the degree of cooperation given to the councils by their institutes' administration and faculty. We, in the Minnesota delegation, came away from the conference confident that the faculty and administration from the University of Minnesota are among the most cooperative and understanding in student affairs. At the same time our delegation felt responsible to make the Tech Commission rise to its potential for serving the Institute of Technology.

Next year's conference will be held at Ohio State University. We hope that the representatives will attend an equally as beneficial conference as we did this year.

Bruce D. Nelson
Tech. Commission

IT Red Tape Cut

The Assistant Dean's Office 133E is moving to the south end of Main Engineering—hopefully before the start of Winter Quarter. For information and assistance go to room 105E.

Tutoring services for Mathematics, Physics and Chemistry will be continued during Winter Quarter. We encourage you to utilize these worthwhile services. Further information available in 105E.

Our commuter tutoring program for Fall Quarter was a success and we invite new students to join us Winter Quarter '71. Enjoy 4 delicious evening meals at Centennial Hall along with Math tutoring sessions scheduled before quizzes. To purchase meal tickets (for $6.00) and to obtain further information inquire at 105E.

In case you haven't heard—I.T. students may cancel a course *without grade* regardless of academic performance up to and including Study Day. To do so file a cancel slip signed by your advisor in room 105E.

Students who receive D or I grades or a grade point average (GPA) below 2.0 should talk with your advisor at the start of the quarter. He may want to recommend a change in your Winter Quarter Program and this should be accomplished no later than the first few days of the quarter.

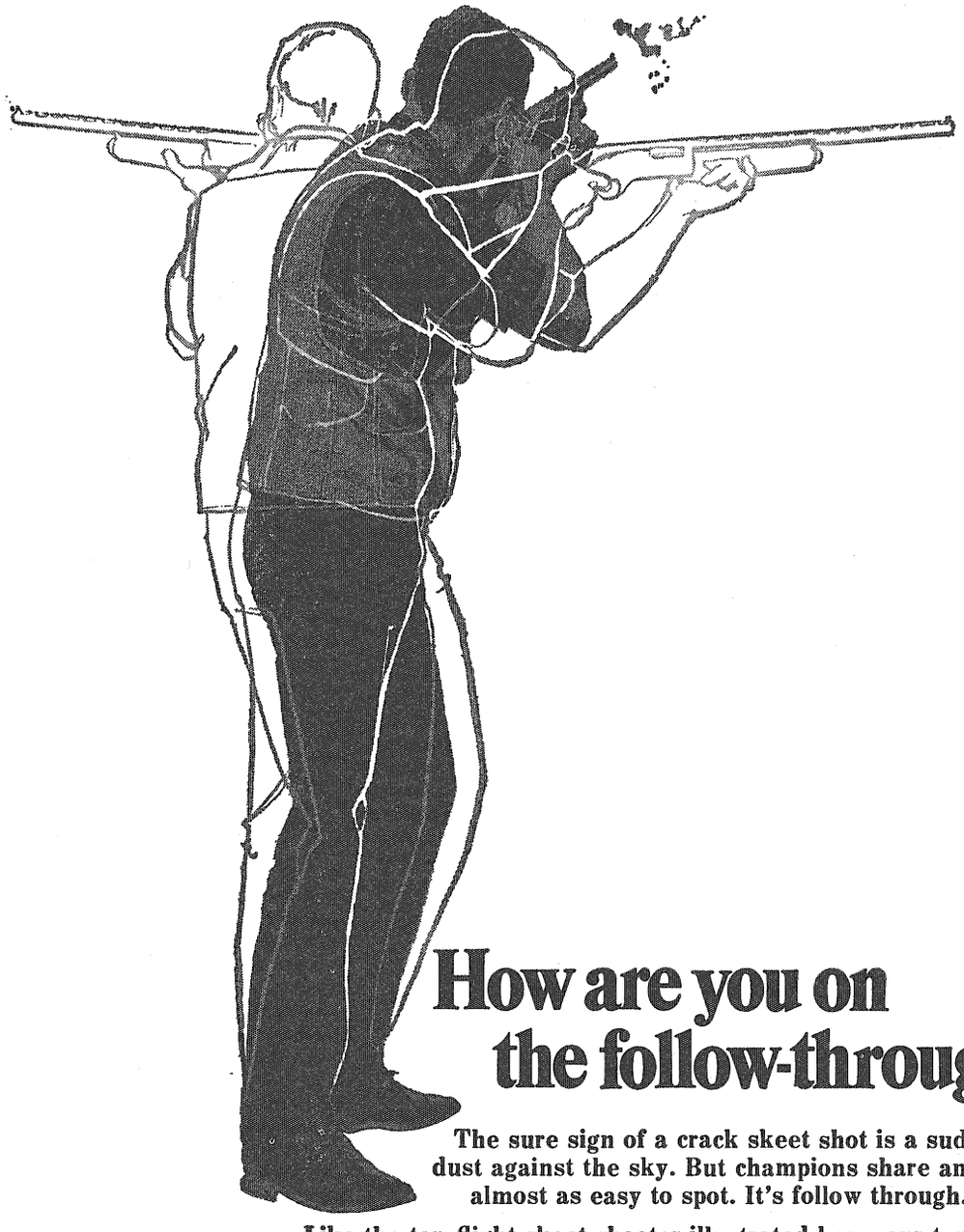
Best wishes for a successful quarter and a restful and joyous quarter break. Merry Christmas and Happy New Year to ALL!

Dr. John Clausen,
Director of Lower
Division Programs

Tech Board

Technolog Board, the governing body of the *Minnesota Technolog,* met for the first time this year on December 3. The board is composed of eight voting members: Paul Cartwright, John Clausen, Clifford Haga, and Lee Ponto are the faculty advisors with Robert Anderson, John Huggins, Bill Tuynman and John Uttermoehl as student members. The editors, Frank Collins and Marvin Vikla as well as the business manager JoAnn Hanson are non-voting members.

Bill Tuynman and John Huggins were elected President and Secretary of the Board, respectively. The meeting consisted mostly of an exchange of information between the Board and the Editors. It was decided that the Board would meet the first Tuesday after publication unless it conflicted with the holidays.



How are you on the follow-through?

The sure sign of a crack skeet shot is a sudden puff of clay dust against the sky. But champions share another mark that's almost as easy to spot. It's follow through.

Like the top-flight skeet shooter illustrated here, our tapered roller bearing and steel engineers get results because they follow through, too.

How about you? Do you want a company that involves your interest and keeps you involved till the finish? That promotes from within? Are you up to the demands thrown our way by the automotive, construction, aerospace and chemical industries? Do you have your sight set on the future—on a company like ours that has a $221 million expansion and modernization program?

Then write to our Manager of College Relations. And tell him you'd like to take a shot at it. The Timken Company, Canton, Ohio 44706. Timken® bearings are sold all over the world. Manufacturing in Australia, Brazil, Canada, England, France, South Africa and the U.S.A.

An Equal Opportunity Employer (m/f).

On your campus...
February 8, 1971
A Timken Company representative would like to talk with you.

TIMKEN®
REGISTERED TRADEMARK

THE TIMKEN COMPANY MANUFACTURES TAPERED ROLLER BEARINGS, FINE ALLOY STEEL AND REMOVABLE ROCK BITS.

LOG'S LOG

BY ACE & ZEUS

INTRODUCTION:

'Tis the season to be jolly, but not for the expeditionary force. It seems that the triumvirate of the Technolog is still trying to cook our goose. Too bad they haven't heard about the duck that flew upside-down . . . he quacked up!!!

Lush's Corner

What would the holiday season be without a little holiday spirit(s) to perk you up? Cornered with this pertinent query, the E-F team decided to add a little Christmas cheer with the first disclosure of "EGG-LOG" (as prepared by Brucie's Bar and Body Shop). Shake one egg, a teaspoon of powdered sugar, and one jigger of brandy. Next, strain this mixture into a ten to twelve ounce glass of cold milk. If you're lazy, like yours truly, you can just add a jigger of brandy to any prepared dairy eggnog.

May your holiday season be as merry as this concoction will make you!!!

The Joy Is In The Giving

It's that time of the year again for the old Yule LOG to be dragged out. This is the season when everyone makes out—Christmas lists of what he wants but will never get. The E-F team has decided to remedy the situation by granting everyone his Christmas wish. (Some groups have already been blessed by our presence and presents!) Below is the E-F's shopping list. Read it, ho-ho-ho, and have a Merry Christmas!!

For the Black Panthers: 1000 "We Love Whitey" buttons.

For George Wallace: A year's supply of soul food.

For Hugh Hefner: An IT co-ed.

For all effete, impudent snobs: A Spiro Agnew voodoo doll.

For each FREE member: A $3 bill.

For our token freshman: A rubber-ducky Raquel Welch.

Official Daily Bull

The Expeditionary Force, during one of our recent meditation sessions around the "Old Spiked Keg," discovered that 1970 has come and gone and all we have to show for it are ulcers, dishpanned bodies, a growing pain in the posterior, and a pair of sized-up slipsticks. To top it all off the beer has gone flat. I guess it's all summed up by that quaint old expression, "Once a King always a King, but once a Knight is enough!"

So with tarnished armor, we bid farewell to another year.

Dec. 16-31

16—Over the hump day.
18—Hump Day (Does Hubert Humphrey?)
24—Nick's night out.
31—Old aching head day.

Jan. 1-15

1 —On this date 81 years ago the GAY '90's officially began.
8 —National Sugar Smacks and beer day.
10—Start of National Germ Week (don't spread it around).

ACE'S ADVICE FOR THE MONTH

Gather 'round folks, it's time to get another piece of Ace('s fine advice).

First, for all you co-eds: wear mistletoe around your neck only at your own risk, because there is nothing a guy enjoys more than kissing a girl under the mistletoe!

Now, Ace comes to the rescue of all you engineers who can't think of anything to say to your girl during those precious moments under ye olde mistletoe. (However, if your girl has more than a green belt in judo, forget it—it's not worth the pain.) Never fear, though, Ace has already tried the following little ditties on his baboon beauty. Out of the five one-liners, three only drew blood, while the other two required hospitalization. (Actually, I had another one but she threatened to make the "unkindest cut of all" if I printed it!!)

"What do you mean, you've got mono?"
"I will if Yule . . ."
"Where did you learn to kiss like that—siphoning gas?"
"**Caution:** Mistletoe may be hazardous to your health!"
"When can I unwrap my present?"

CONCLUSION:

With pronounced vigor the E-F researchers pursued this month's pressing problem: "How does Old Nick make it back up the chimney?" Immediately we narrowed the problem down to two possibilities: (1) For an instant, gravity fails (i.e. the earth stops sucking); or (2) Santa has the worst case of post-nasal drip known to man!! However, since our noble staff finds this hard to believe we offer two more solutions: He eats four pounds of prunes before he starts; or Saint Nick gets the biggest "gotcha" anyone has every seen!!

Can you cut costs without cutting corners?

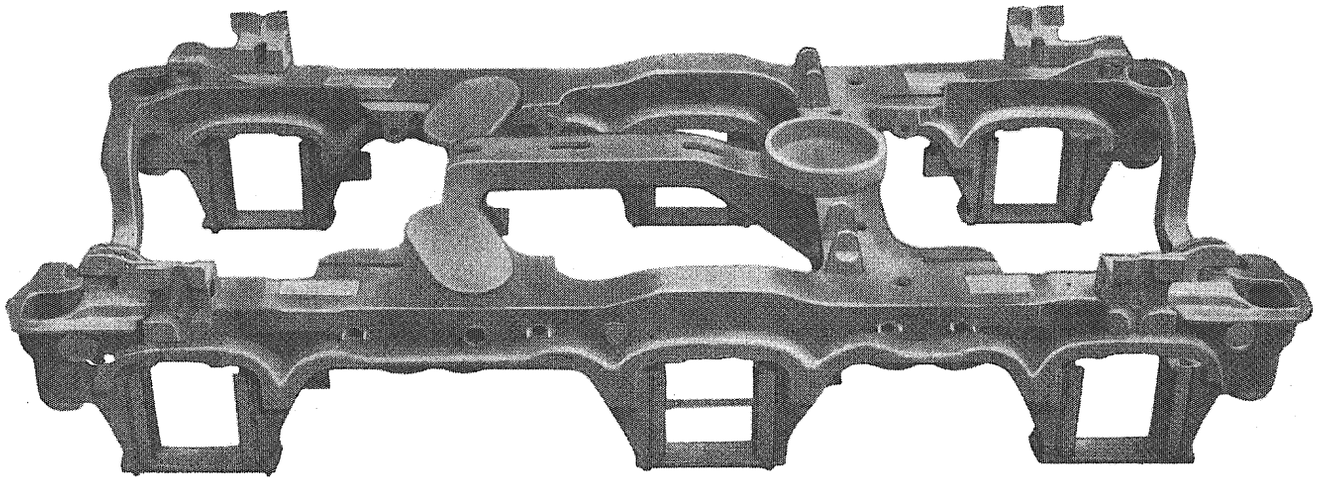
The designer of this six-wheel diesel locomotive truck frame did...that's why he chose *cast-steel*.

Using smooth fillets and fairings possible only with casting, he eliminated stress concentration caused by the corners and angles of wrought structures. To keep weight low without sacrificing strength, he varied section thickness, concentrating steel at the points of maximum stress.

And with *cast-steel* he got substantial savings in the bargain. One-piece construction eliminated assembly costs. Holes, slots and channels were cast-in directly. With the greater dimensional control inherent in casting, finishing costs on the 8 x 18 foot frame were cut to a minimum...Compare this with the tedious assembly, machining and finishing work that goes into a welded or bolted structure.

Want to know more about *cast-steel?* We're offering individual students free subscriptions to our quarterly publication "CASTEEL." . . . Clubs and other groups can obtain a sound film "Engineering Flexibility." Just write Steel Founders' Society of America, Westview Towers, 21010 Center Ridge Road, Rocky River, Ohio 44116.

STEEL FOUNDERS' SOCIETY OF AMERICA



Cast-Steel
for Engineering Flexibility

Editor's note: The following article reflects national trends in employment. For local statistics, please refer to Log Line Nov. 1970.

Future engineers, this Great Seal of Minnesota could become a familiar sight to you within several years. Where is it found?—The Minnesota Department of Employment.

MISSION IMPOSSIBLE?

by Mike Chase

It sounds ridiculous to be concerned about unemployment before you are even employed, but it is a distinct possibility. By looking at predicted and actual trends, one will see that certain success in industry is a thing of the past.

The Engineering Manpower Bulletin attempts to project the supply and demand of engineers through 1978. There is no single factor controlling the demand for engineers, but rather there are several.

Presently, the biggest uncertainty is the unpredictable effect of the draft. Although the recent changeover to the lottery system has eliminated much guesswork, the unstable international scene still prevents definite predictions of Selective Service requirements.

Another influence on the job market is the sudden influx of foreign nationals into the U. S. Some come as students and remain to work here after graduation. Others receive their education abroad and then enter the country seeking employment. Close to 10,000 immigrants join our work force as engineers every year. Two months ago, the Engineers Joint Council issued a letter to Secretary of Labor Hodgson urging that prospective immigrant engineers be required to have a job offer before entering the United States. Again, this factor is rapidly changing—depending upon U. S. immigration quotas.

Recent cutbacks in research and space programs, the slowdown in the national economy, and some shifts in national priorities have caused a definite lag in new job openings. Industry can now take its pick from the cream of the crop. Since World War II, the gap between engineering manpower demand and the supply of new graduates has created opportunities for non-graduates. For the next several years, there will be little or no room in industry for these non-graduates. It may even come to the point where those holding degrees will be turned away.

The industry slowdown is reflected in a cutback in college recruitment advertisement. The *Minnesota Technolog*, for example, has noted that many companies which had been regular advertisers in the past have now withdrawn their ads. They have no real need to advertise as a result of the surplus of engineers. There are currently many graduates across the country who write to companies seeking any available employment.

In general, the demand for engineers will continue to drop through at least 1971. If the national economy responds as predicted, employment opportunities should steadily rise through 1974. This is borne out in Figure #1.

The next logical question is "How many engineers will be in competition for these jobs". As exhibited by Fig. #2, the supply of U. S. engineers available to join industry will steadily increase. By 1974, our colleges will be producing over 43,000 engineers available for immediate employment every year.

In order to meet the keen competition, some engineering grads continue their education to obtain a MS or PhD degree. The number of such degrees is predicted to double in the next five years! (Fig. #3) Not only do MS and PhD's receive better pay, but they also enjoy the added job security.

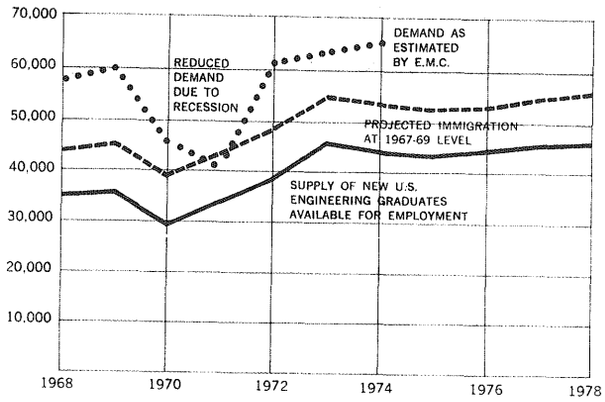


Figure 1, Current and projected manpower supply and demand.

Many people wonder how the engineering manpower picture can go from a chronic shortage to an obvious surplus. The September issue of the *Engineering Manpower Bulletin* sums up the situation nicely:

"The answer, of course, is that the need for more engineers is basic and long range while the immediate job market is determined by all kinds of other factors. The absence of an underlying national policy with regard to high-level manpower is all too clearly revealed in the results of uncoordinated actions such as precipitous federal budgetary cuts, shifts in monetary policy, changes in Selective Service regulations, and revised immigration laws. The nation's supply of technologically educated manpower is too valuable a resource to be wasted in "boom and bust" cycles in which engineers are the unhappy victims of events and decisions beyond their control."

The only alternative for the prospective engineer is to remain alert to changing employment opportunities. He must also constantly re-evaluate his future goals and correlate them with the changing employment situation. It might be advantageous to consider grad school, too. If one does not take every possible effort to insure a place in industry for himself, he could very well end up spending much of his life in an employment office.

ACTUAL AND PROJECTED ENGINEERING DEGREES AWARDED BY U.S. SCHOOLS, 1965-1978

Year	MS Degrees	BS Degrees	PhD Degrees	Total Engrg. Degrees
1965	36,700	12,100	2,100	50,900
1966	35,800	13,700	2,300	51,800
1967	36,200	13,900	2,600	52,700
1968	38,000	15,200	2,900	56,100
1969	40,000	15,000	3,300	58,300
1970	40,300	15,600	3,600	59,500
1971	39,900	17,100	3,900	60,900
1972	44,800	20,300	4,300	69,400
1973	45,900	22,200	4,800	72,900
1974	47,500	24,200	5,300	77,000
1975	49,000	26,200	5,800	80,900
1976	50,600	28,000	6,300	84,900
1977	51,900	30,000	6,800	88,700
1978	53,200	32,000	7,400	92,600

Source: Engineering Manpower Commission, U.S. Office of Education, and Commission on Human Resources and Advanced Education.

Figure 3, Actual and projected engineering degrees Awarded by U. S. schools, 1965-1968.

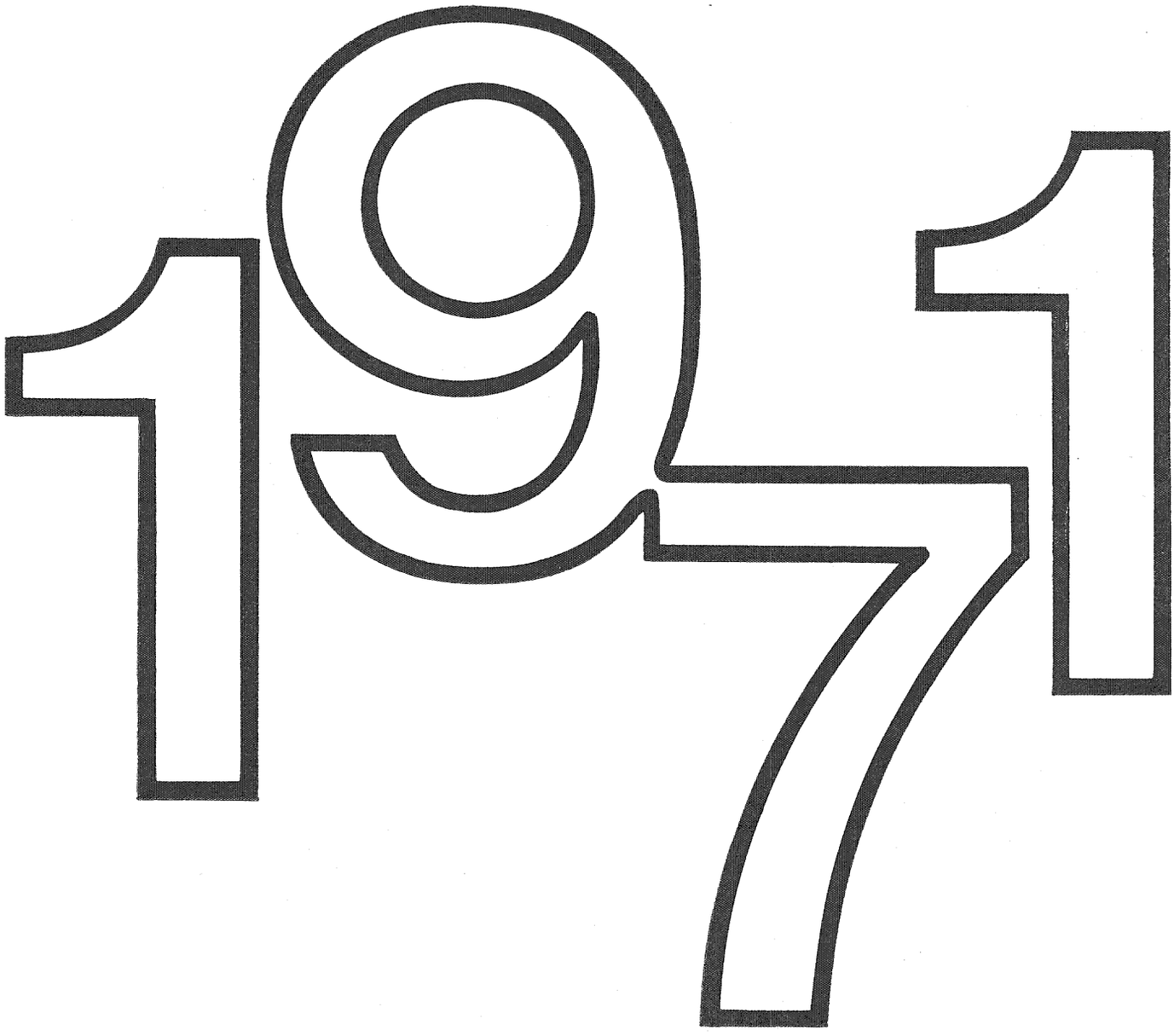
Figure 2.

ESTIMATED SUPPLY OF NEW ENGINEERING MANPOWER, 1965-1879

1. Year	2. First Time Degree Credit Enrolments, Male, All Schools	3. Percent Engrg. Juniors 2 Years Later	4. Engrg. Juniors	5. Percent BS Deg. 2 Yrs. Later	6. Engrg. BS Degrees	7. Number Lost or Delayed	8. BS Avail. For Employment	9. Delayed Mil. & Grad. Entrants	10. Total New U.S. Engrs. Available
1965	829,000	6.09	40,800	88.7	36,700	15,000	21,700	10,000	31,700
1966	788,000	6.38	45,000	88.4	35,800	14,500	21,300	10,500	31,800
1967	820,000	6.09	50,500	79.2	36,200	15,000	21,200	10,600	31,800
1968	844,000	6.01	50,300	80	38,000	13,900	24,100	11,200	35,300
1969	881,000	5.93	49,900	80	40,000	13,400	26,600	9,000	35,600
1970	922,000	5.86	50,700	88	40,300	19,900	20,400	9,400	29,800
1971	959,000	5.81	52,200	88	39,900	18,000	21,900	11,200	33,100
1972	995,000	5.78	54,000	88	44,800	18,400	26,400	12,200	38,600
1973	1,024,000	5.75	55,700	88	45,900	19,300	26,600	18,900	45,500
1974	1,056,000	5.72	57,500	88	47,500	20,800	26,700	16,800	43,500
1975	1,085,000	5.70	59,000	88	49,000	22,400	26,600	16,200	42,800
1976	1,103,000	5.68	60,400	88	50,600	24,000	26,600	16,900	43,500
1977	—	—	62,300	—	51,900	25,500	26,400	18,400	44,800
1978	—	—	63,600	—	53,200	27,000	26,200	19,800	46,000

Source: Engineering Manpower Commission, U.S. Office of Education, and Commission on Human Resources and Advanced Education.
Refer to text for further explanation of data and factors used.

If you are a senior...



could be the most important year of your life.

As you contemplate one of the most important decisions of your life, you will want to remember this: it is not just "a job" you are seeking—it should be the beginning of a career. And if it is to be successful, both you and your employer must need and want each other.

To help you with your decision, we invite you to consider the opportunities at Pratt & Whitney Aircraft. Currently, our engineers and scientists are exploring the ever-broadening avenues of energy conversion for every environment . . . all opening up new avenues of exploration in every field of aerospace, marine and industrial power application. The technical staff working on these programs, backed by Management's determination to provide the best and most advanced facilities and scientific apparatus, has already given the Company a firm foothold in the current land, sea, air and space programs so vital to our country's future.

We select our engineers and scientists carefully. Motivate them well. Give them the equipment and facilities only a leader can provide. Offer them company-paid, graduate-education opportunities. Encourage them to push into fields that have not been explored before. Keep them reaching for a little bit more responsibility than they can manage. Reward them well when they *do* manage it.

Your degree can be a B.S., M.S., or Ph.D. in: MECHANICAL ENGINEERING • AERONAUTICAL ENGINEERING • ENGINEERING SCIENCE • ENGINEERING MECHANICS.

If your degree is in another field, consult your college placement officer—or write Mr. Len Black. Engineering Department, Pratt & Whitney Aircraft, East Hartford, Connecticut 06108.

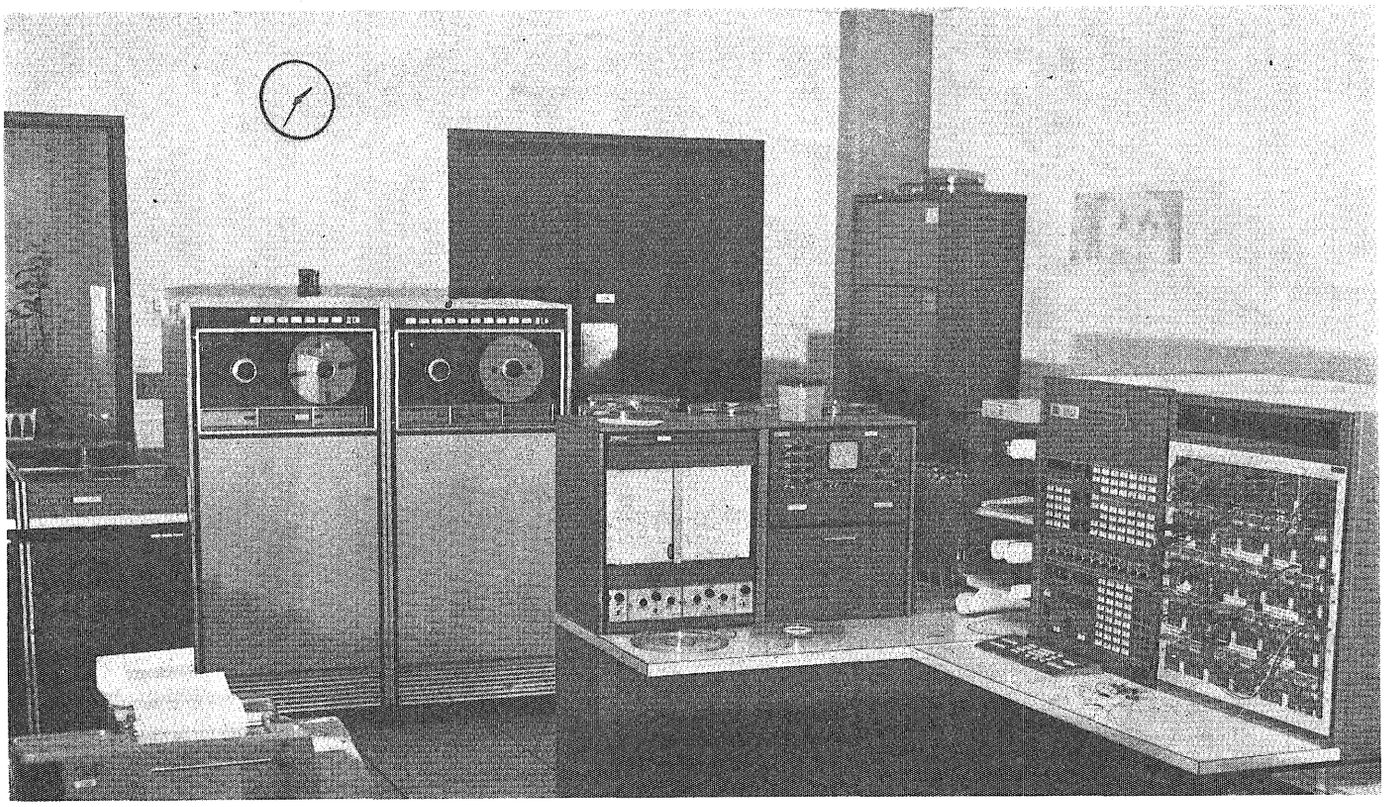
Pratt & Whitney Aircraft

EAST HARTFORD AND MIDDLETOWN, CONNECTICUT

U A

DIVISION OF UNITED AIRCRAFT CORPORATION

An Equal Opportunity Employer

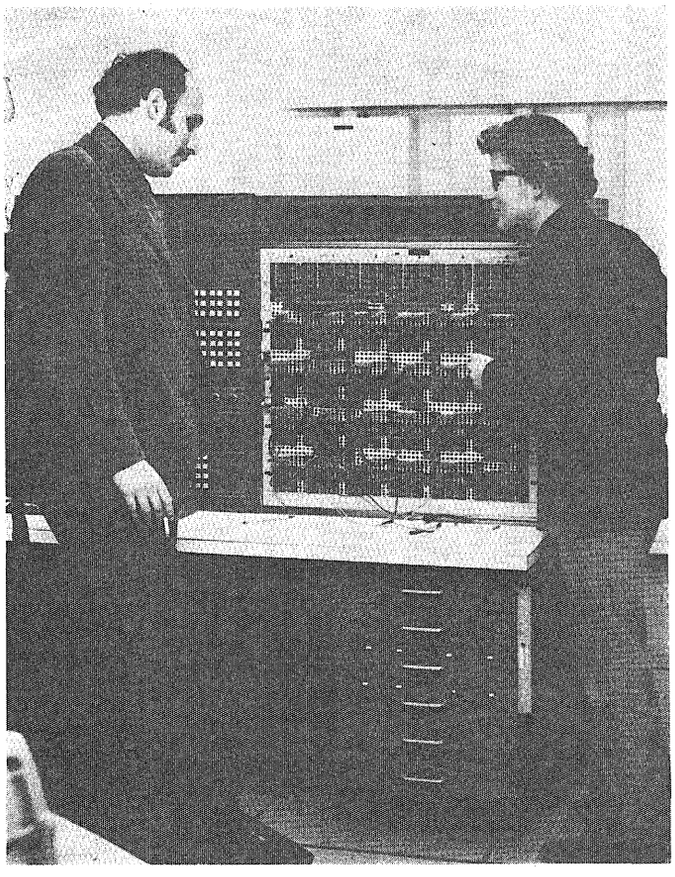


INTRODUCING . . .

HYBRID COMPUTER CENTER

by John McFeters

Dr. Kahne talks with John Salasin, manager of computer graphics at the center.



Located on the first floor of the Space Science Center of the University of Minnesota is an unique collegiate instructional, research and service computer laboratory. The Hybrid Computer Center, directed by Dr. Stephen Kahne, serves university students and faculty and certain non-university agencies with problem solving capabilities available at no other school in the county.

The center features a hookup of two EAI 680 analog computers and one Control Data Corp., 1700 digital computer by means of a CDC 1500 series interface linking unit. Standard peripheral input and output components for both the analog and digital computers plus

a special graphics terminal totals the principle equipment of the center.

The interface unit is the communications center for combining the functions of the different types of computers. It is a two way system for digital-analog and analog-digital relay using Fortran computer language.

University students and faculty may have access to the Center's computers for a variety of purposes. Students can work in the Center in order to become familiar with sophisticated data processing equipment, and they may conduct research and data analysis in their specialty areas such as original research for theses.

Faculty members may also aid their research needs by using the Center's equipment. The potential of the Center as a teaching-aid for faculty and as a learning-aid for students is being further explored.

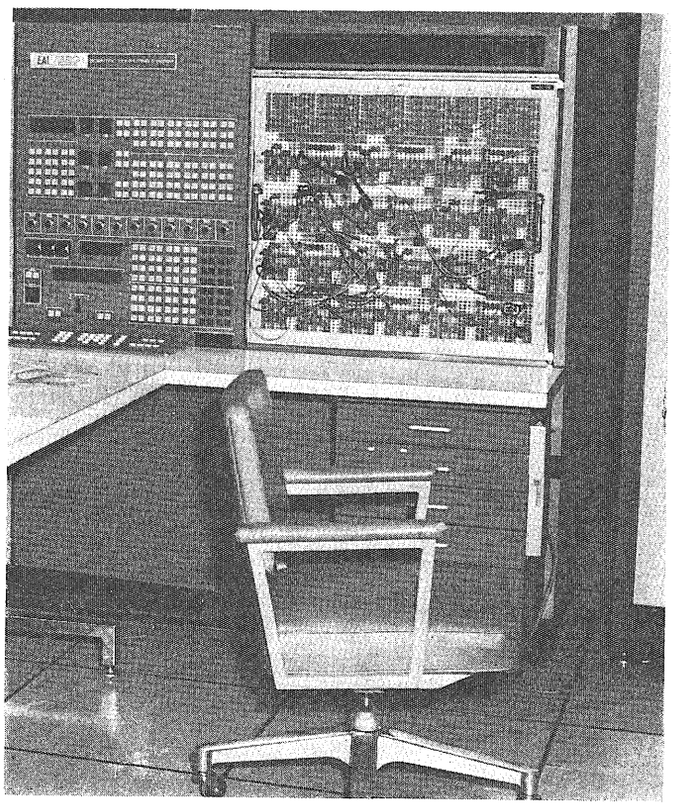
The staff of the center is completely comprised of students with the exception of Doctor Kahne. Staff members act as "operators and assistants" for researchers who have need of the Center's capabilties, but have insufficient knowledge to operate the equipment.

State agencies and local industries also make use of the Center's equipment and staff members. One recent program completed for the state Pollution Control Agency was to build a data base for future assessment of environmental and pollution problems of the rivers of the State of Minnesota.

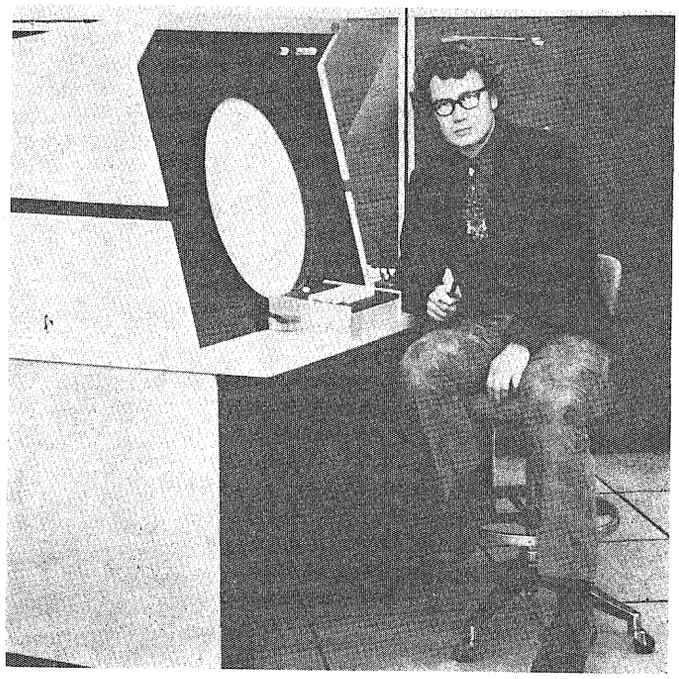
In one project for private industry, the graphics terminal, a CDC 274 Digigraphics console, is used to allow architects to communicate with the computer. The computer can store files on such architectural data as cubic space, heating, lighting and people flow. By means of the graphics unit, architects can feed a blueprint into the computer; the computer then can interpret the blueprint in light of data files stored. All the possible combinations and variations produced by the computer then can be analyzed by the architect for final decision.

The complete magnitude of the Center's potential is overwhelming. Not only do the three computers work outstandingly together, but they can be used separately. This furthers the capabilities of the Center in both the types of functions performed and also in the volume of functions handled.

An EAJ 680 analog computer is programmed with external wiring.



Dr. Kahne operates the 1700 computer (above) and the 274 Diagraphics console (below).



photos by Ron Reichenberger

are precision-forged in a single blow by TRW's Equipment Group in Cleveland. The final configuration of the 30-inch blades is machined to extremely close tolerances on numerically controlled equipment. Thirty-eight blades are used in each of the three General Electric CR6 engines which power the new DC-10 airbus.

"Year of the Truck"

Detroit, Mich.—Last year was the "Year of the Truck" according to **Motor Truck Facts** published by the Automobile Manufacturers Association. The yearly production of trucks and buses reached a record high of more than 1.98 million vehicles. Nearly 10,000 more than the previous record year.

Only about half of the new trucks replaced vehicles taken off the road as national registration gained more than 944,000 units to total more than 17.88 million at the beginning of this year. Bus registrations also moved up about 12,000 units to reach a total of 364,000 including about 273,000 school buses.

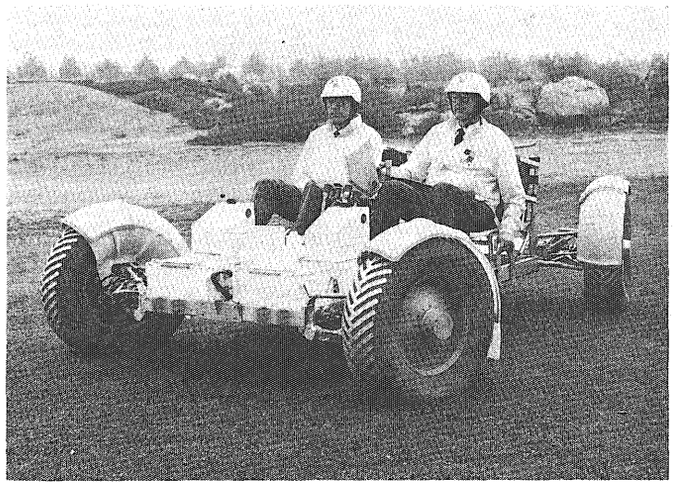
The pickup truck remained as the favorite truck-body style accounting for about 55 percent of factory sales, but the van style truck moved up in popularity gaining more than 25,000 units over previous year's sales.

Trucks continued to play an important role in the national economy. In 1969, trucks hauled about 404 billion ton-miles of intercity freight, and moved about 51 percent of intercity tonnage of manufactured goods excludink petroleum and coal products. Also, more than 10 million persons are employed in commercial vehicle production, sales, servicing and use.

The LRV

A Lunar Roving Training Vehicle designed exclusively for the astronaut training on Earth has been delivered to the National Aeronautics and Space Administration by the Boeing Company. The vehicle is called the "L-G trainer. Although appearing like the two-man flight-model Lunar Roving Vehicle, the trainer is about twice the weight of the flight version. Added strength in the frame, wheels, drive motors and suspension system is necessary because the astronauts and their scientific payload are six times heavier on earth than they will be on the moon.

LRV is scheduled to be carried to the moon on Apollo 15 in July 1971. The trainer is 10 feet 7 inches long, almost 6 feet wide and has 7½-foot wheel base. The four wheels are individually powered by electric motors. The driver uses a hand controller, somewhat like an air-



craft "stick," rather than a steering wheel. The trainer and flight models can move forward and backward at variable speeds up to nine miles an hour on a relatively smooth surface. Automobile type tires are used instead of the wire mesh wheels of the flight vehicles. Two nickel cadmium rechargeable batteries provide power for the trainer, but the thermal mirrors and heat sinks used for cooling in the moon's environment will not be used on Earth. The trainer uses electric fans for cooling. The trainer can carry a total weight of 800 pounds which includes two astronauts, scientific equipment and rock samples.

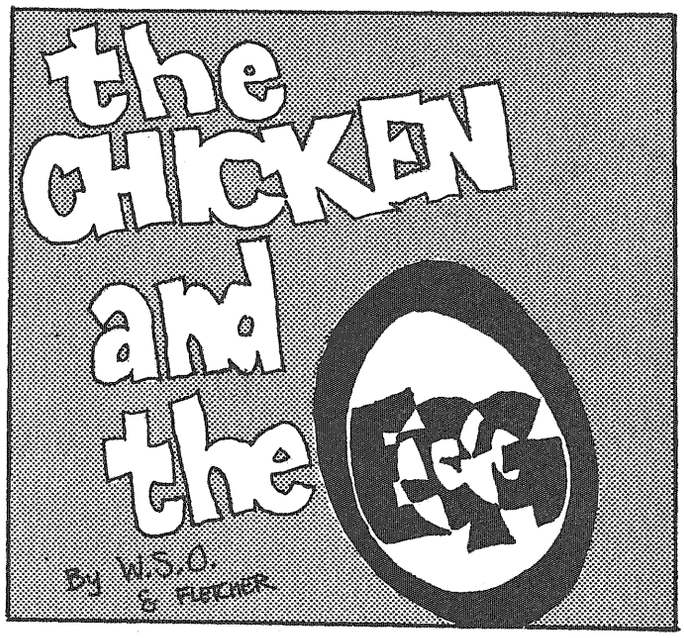
Boeing 747

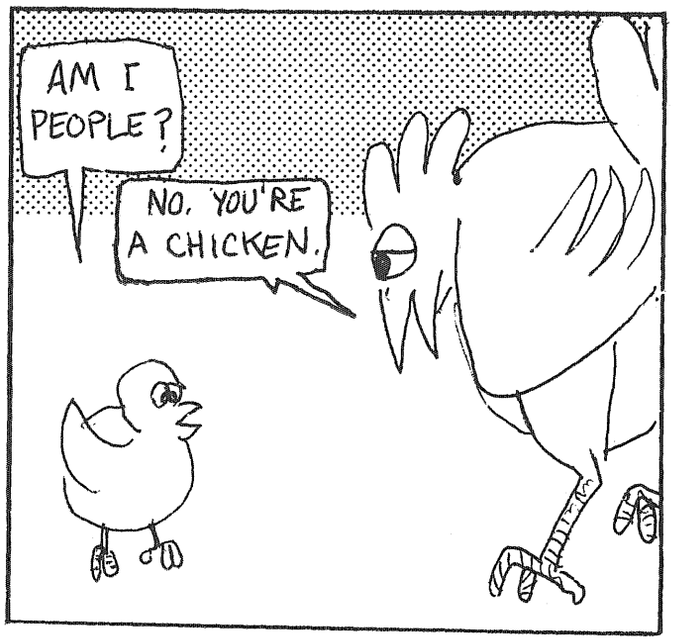
A 735,000-pound gross weight version of the basic 747, representing added range and payload capability, is now being offered by the Boeing Company. Increasing the weight of the 710,000-pound superjet became possible when tests showed the wing strength to be 116 per cent of ultimate design requirement.

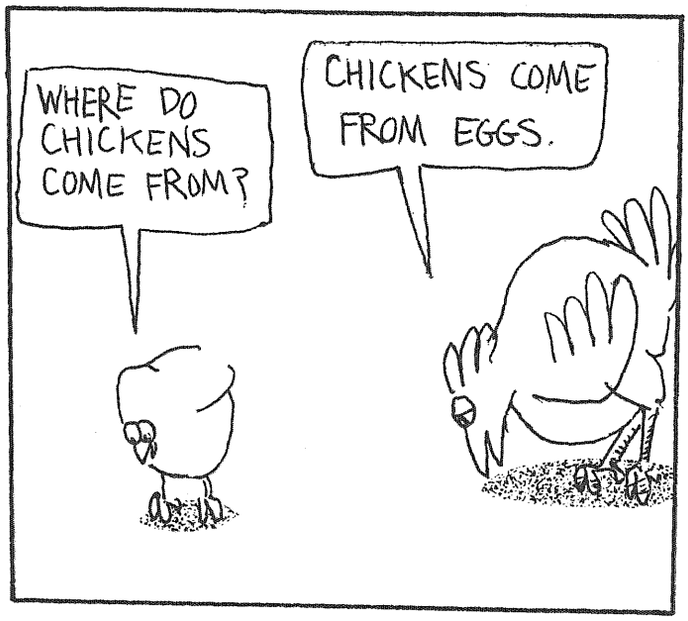
The new gross weight makes possible added payload of up to 15,000 pounds, a range increase of 400 miles, or a combination of range and payload increases.

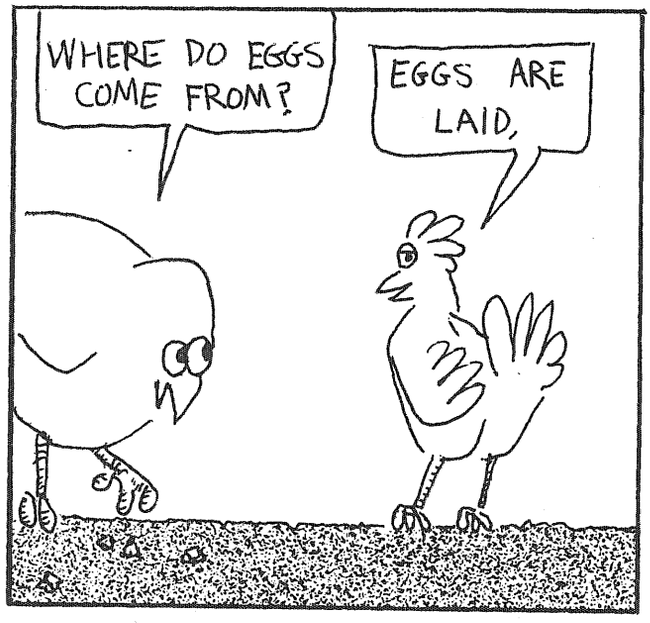
Changes necessary to accomplish the gross weight increase include: revised side-of-body wing ribs; new tires; use of the JT9D-3AW engine version, which includes water injection, giving 45,000 pound maximum rated static thrust, or the JT9D-7 engine which, when it becomes available in late 1971, will produce 45,000 pounds of thrust without water injection.

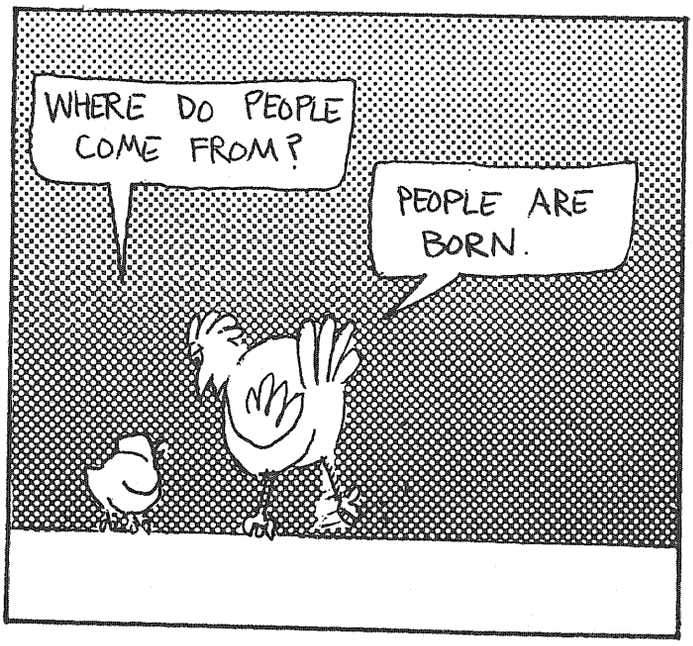
Testing of the airplane's performance at 735,000 pounds gross weight will be conducted with the original 747, which spearheaded earlier 747 certification testing. Certification of the airplane at the higher weight is expected early next year.

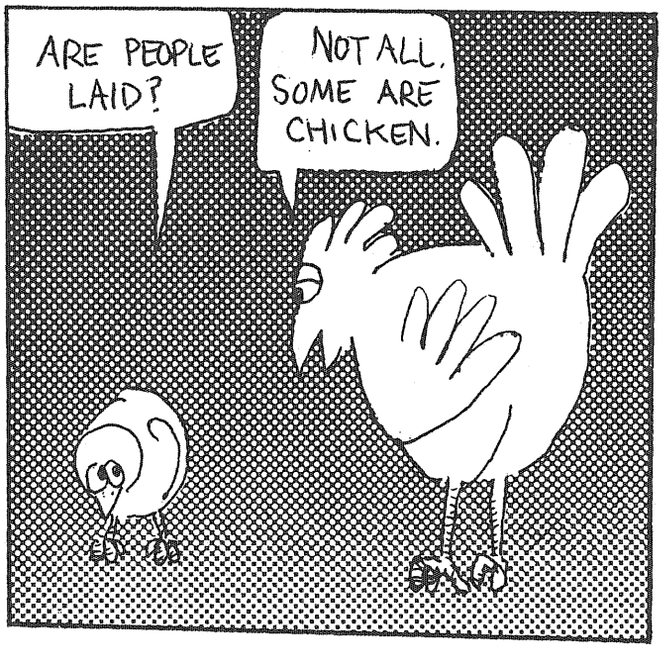

the CHICKEN and the EGG
By W.S.O. & FLETCHER


AM I PEOPLE?
NO. YOU'RE A CHICKEN.


WHERE DO CHICKENS COME FROM?
CHICKENS COME FROM EGGS.


WHERE DO EGGS COME FROM?
EGGS ARE LAID.


WHERE DO PEOPLE COME FROM?
PEOPLE ARE BORN.


ARE PEOPLE LAID?
NOT ALL. SOME ARE CHICKEN.

Splinters

—vilitas et crudas semper ternam

by BARRY JOHANSEN and RALPH POLKINGHORNE

Once, during a bad rain storm, three roosters found themselves caught in the downpour. Two of them ran for the barn, the third and smarter one, made a duck under the porch.

• • •

Do you know the difference between rape and seduction?

It's all a matter of patience.

• • •

"Daughter", said the mother, "didn't I tell you not to let young men up to your apartment?" "You know how that worries me."

"Don't be ridiculous mother," replied the girl. "We went to his apartment. Now let his mother worry!"

• • •

Rudeness is: Kissing your 84 yr. old aunt goodby and she slips you the tongue.

• • •

Double rudeness is slipping it back.

• • •

"Yes, it's a nice little apartment, but I don't see any bath."

"Oh, I'm sorry, I thought you were one of those forester boys who wanted a place for the winter."

• • •

An E.E. met another the other day and the following conversation ensued:

"Where did you get the new bike?"

"Well, I was walking through the woods the other day and a girl came up to me, riding this bike." "She got off, ripped off all her clothes, and told me I could have anything I wanted, so I took the bike."

The other replied:

"That was a smart move, the clothes wouldn't fit you anyway."

The only feeling Ag. students have for women is in their hands.

• • •

Definition of a virgin: an ugly 6th grader.

• • •

The Logs answer to 'Evening in Paris' perfume is called 'Three nights in Chicago.'

• • •

"Do you say prayers before you eat?"

"No, I don't eat University food."

• • •

A wild goose is one that is an inch off center.

"I won't say I'm getting old," the aging duffer told his golfing partner, "but lately my sex drive's turned into a putt."

• • •

The good old days were those when Uncle Sam lived within his income, and without most of ours.

• • •

Log. Editor (on phone)—Say, I got a leak here in the office.

Plant Services—"Go ahead, it's your office."

• • •

And as Dean Martin would say "Ya seen one, ya seen 'em both!"

• • •

Sign in University Computer Center:

Achtung!! Alles Lookenpeepers.

Das computeren ist nicht fur gefingerpoken und mittengrabbin.

Ist easy schnappen der springenwork, blowen fusen, und popencorcken mit spitzensparken. Rubbernecken sightseeren keepen das hands in das pockets. Relaxen und watchen das blinkenlights.

People going to work.

What will they do when they get there?

Will the work be too hard to take, or too easy to be interesting? What will it accomplish?

That's what "industrial engineering" is all about, even where it does not go by that name. As a branch of engineering, a good bit of it originated in our plants over the past 50 years. Viewpoints have been changing. The futility in thinking of a work force as abstract units instead of fellow humans is now well understood. This attitude is not inconsistent with designing of jobs by rational analysis, including mathematical modeling, instead of tradition.

Some formally educated industrial engineers, as well as mechanical and chemical engineers who think this sort of work might be worth doing (for rather decent pay and benefits) will be invited to practice it with us after they finish on campus at the end of the present academic year or term.

To be considered for an invitation, write:

EASTMAN KODAK COMPANY
Business and Technical Personnel
Rochester, N.Y. 14650

An equal-opportunity employer

Kodak

On your way up in engineering, please take the world with you.

The best engineers are far from happy with the world the way it is.

The way it is, kids choke on polluted air. Streets are jammed by cars with no place to go. Lakes and rivers are a common dumping ground for debris of all kinds.

But that's not the way it has to be.

Air pollution can be controlled. Better transportation systems can be devised. There can be an almost unlimited supply of clean water.

The key is technology. Technology and the engineers who can make it work.

Engineers at General Electric are already working on these problems. And on other problems that need to be solved. Disease. Hunger in the world. Crime in the streets.

General Electric engineers don't look for overnight solutions. Because there aren't any. But with their training and with their imagination, they're making steady progress.

Maybe you'd like to help. Are you the kind of engineer who can grow in his job to make major contributions? The kind of engineer who can look beyond his immediate horizons? Who can look at what's wrong with the world and see ways to correct it?

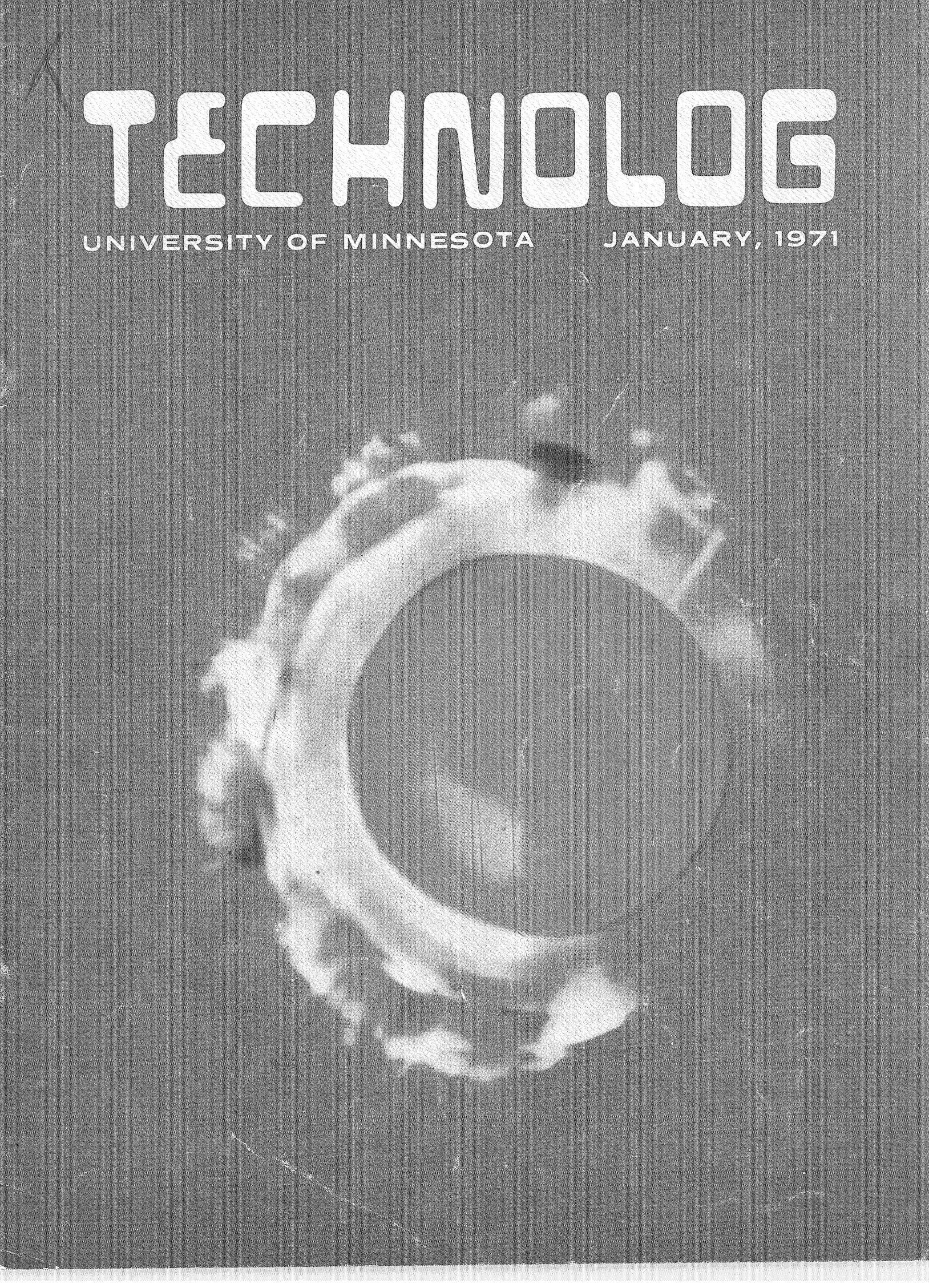
If you are, General Electric needs you.
The world needs you.

GENERAL ELECTRIC

An equal opportunity employer

TECHNOLOG

UNIVERSITY OF MINNESOTA JANUARY, 1971



"They encourage us to look for original solutions to problems. This sparks inventiveness."

Bill Greiner, Western Electric

Bill Greiner's problem: shaving 10-14 seconds off one operation in the manufacture of integrated circuits, while reducing error factor below .001 inch.

Bill is a staff member at Western Electric's Engineering Research Center, working primarily with the handling and testing of integrated circuits.

Bill came to Western Electric in 1968 after receiving his MS from MIT. He earned his BS in Mechanical Engineering at Yale.

"My work here has given me a better appreciation of the problems in manufacturing," said Bill. His automatic TV system for the alignment of integrated circuits is a good example.

At one phase of the manufacturing process, operators must correct alignment of integrated circuits by hand—a job that took up to fifteen seconds, and was accurate to only .001 inch in x and y, and to one degree in rotary.

What Bill did, essentially, was design and build a small dedicated computer that completely automates the process. An operator can push a button to align the integrated circuits automatically. A TV camera enlarges the image in silhouette form, scans the pattern, and feeds the voltage signal into Bill's computer. The computer calculates the position measurements and triggers a stepping table to correct the alignment.

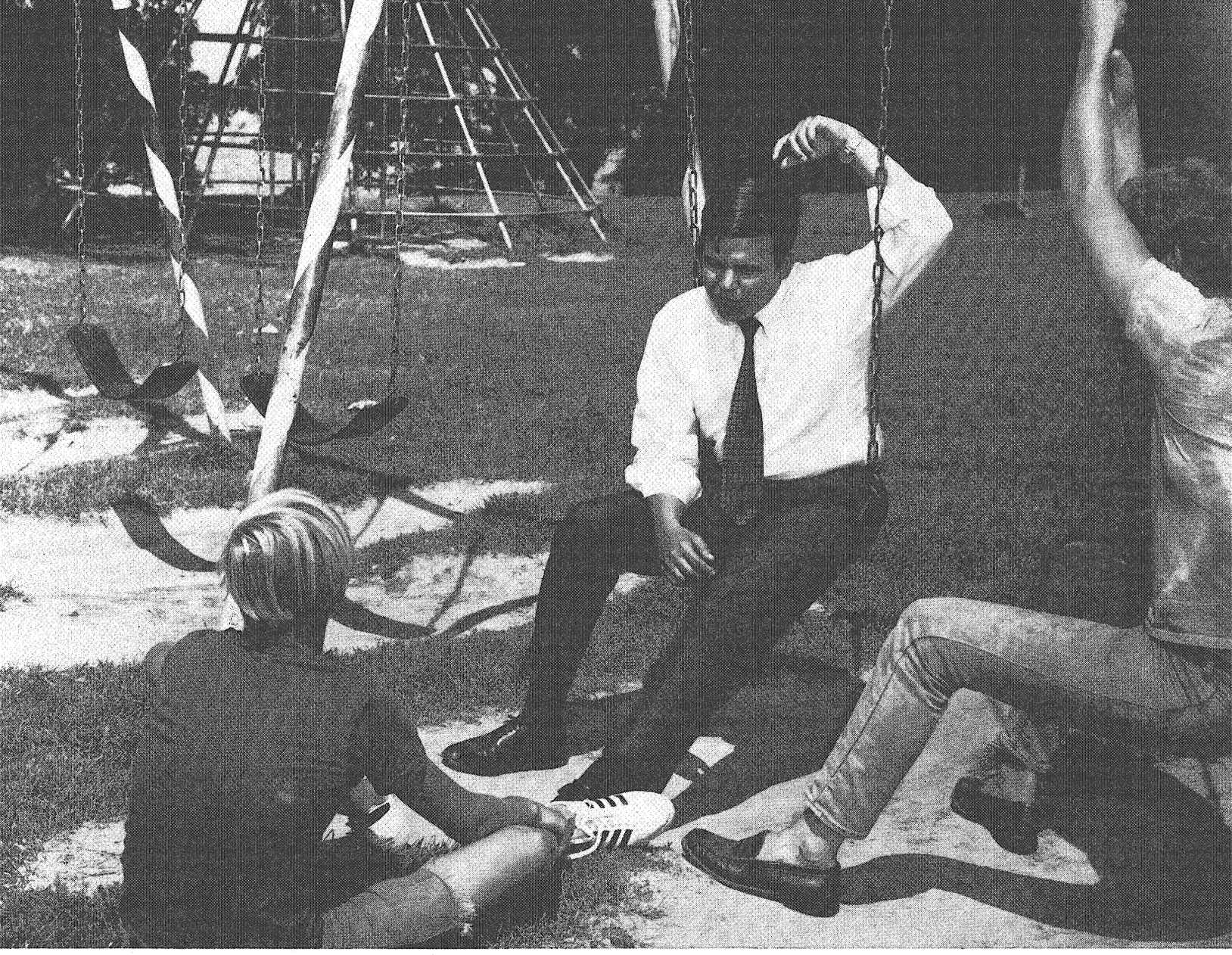
The correction time is reduced to one second, the error factor to .00025 inch in x and y, and ½ degree in rotary.

Bill finds the challenge of electronics and logic design extremely stimulating. "We're not channeled: we have a chance to get involved in a variety of fields."

What does he find most satisfying about his job at Western Electric? "Well," said Bill, "I look for an amount of responsibility. And here I'm encouraged to take it."

Western Electric

An Equal Opportunity Employer



Xerox: For engineers who think of more than engineering.

As far as Frank Betron's concerned, involvement isn't a *responsibility* that comes with success . . . it's a *reward*.

"I'm happy. And I'm lucky. I've got a family I love, a beautiful home, and a job that excites me." Frank's a Senior Mechanical Engineer with our Business Products Group in suburban Rochester, New York. "Things might not have turned out so well if I hadn't gotten a little direction and help when I needed it. So all I'm doing now is passing that help along to other people."

In this case, the "other people" are juvenile offenders. As an active member of the Webster Jaycees, Frank played a pivotal role in organizing a Committee in March 1970 to provide man-to-boy counseling to youngsters on probation. "I interview each one immediately after sentencing. Then I get together with the counselors. We discuss the youth and his problems at length and decide which of us is best suited for that particular case."

"For the most part, these kids just need a little help through a troublesome time in their lives. We try to provide that help by building a little bit of trust between the counselor and the boy."

The desire and need for involvement is a very personal matter. It takes a sensitivity to people as individuals. It takes understanding. It takes a special kind of man. Like Frank Betron.

Xerox is like that, too. If you seek an environment where you're appreciated for the person you are and the engineer you are, why not talk to Xerox. Your degree in Engineering or Science may qualify you for openings in a variety of advanced development, product design and manufacturing engineering areas.

We're located in suburban Rochester, New York. See your Placement Director for a copy of our brochure and for the date of our scheduled campus interviews. Or, write directly to Mr. Roger VanderPloeg, Xerox Corporation, P.O. Box 251, Webster, New York 14580. An Equal Opportunity Employer (m/f).

XEROX

TECHNOLOG

VOL. 51, NO. 4 | Official Student Publication of the Institute of Technology, University of Minnesota | JANUARY 1971

FEATURES

DEPARTMENTS

THIS MONTH'S COVER IS A TONE SEPARATION OF AN ELECTRON MICROGRAPH OF AN IRON ATOM NUCLEUS. PHOTO BY DON NEAL.

MEMBER OF ECMA

Published monthly, October through May. Second-class postage paid at Minneapolis, Minnesota. Office: Room 2, Mechanical Engineering Building, University of Minnesota, Minneapolis, Minnesota 55455. Telephone: 373-3298. Printer: Bruce Publishing Co., 2642 University Avenue, Saint Paul, Minnesota 55114. Publisher's National Representative: Littell-Murray-Barnhill, Inc., 369 Lexington Avenue, New York, New York 10017 and 737 North Michigan Avenue, Chicago, Illinois 60611. Publisher's State and Local Representative: University Engineering Magazine Advertising, F. P. McGrath Manager, Box 14026 University Station, Minneapolis, Minnesota. Telephone 612-225-0708. Member of the Engineering College Magazines Associated, Gordon Smith, Oklahoma State University, Stillwater, Oklahoma. Subscription rate: $3.00 per year, single copies 50 cents. Advertising rates upon request. Any opinions expressed herein are not necessarily those of the Institute of Technology or of the University of Minnesota.

Logline

Everyone likes to talk about it, but nobody wants to act. This sums up the situation concerning our ecology. The following is a national student engineering contest for solutions to, or contributions to the solution of, any technological problems of our environment.

The projects should include one or more of the following topics:

A. Pollutant control and abatement
B. Recycling or beneficial reuse of pollutants
C. Environmental Distribution of pollutants
D. Impact of pollutants on natural ecosystems

One might investigate these topics from the following points of view:

A. Household and personal pollutants (cars, etc.)
B. Industrial pollutants (utilities and industrial plants)
C. Recreation pollutants (outboard motors)

This contest is restricted to full-time college seniors atending U. S. colleges which are members of ASEE and any graduate students who are attending at least half-time and not employed by either industry or government.

Four prizes will be awarded annually. First prize is $1,000 and a certificate. The three runners-up will receive $250 each and a certificate.

Consideration will be given to quantitative environmental projects in order to insure engineering focus. Judging will stress quantitative environmental measure so that engineering content, application, and methodology will be included. Each entry will be judged according to these characteristics:

Economic and/or social benefits derived from the system
Technical feasibility
Implementation capability
Design and development of presentation

The entries will be evaluated by a panel appointed by the ASEE Environmental Engineering Division and representing various disciplines which relate to the scope of the program.

Submit the attached Entry Form (which can be picked up in 105 Main Engineering) and your project report no later than April 15, 1971 to:

W. Leighton Collins
Awards Program Administrator
American Society for Engineering Education
One DuPont Circle, Suite 400
Washington, D. C. 20036

All entries must include the entry form, the project narrative, and all supporting data, charts, graphs, photographs, etc.

The awards will be announced and presented at the annual business meeting of the ASEE during its annual conference in June.

Do you keep an eye on the time line?

To gain the competitive edge, the experts in downhill slalom have this advice: "Watch the time line—the fastest course line."

"In the race against time, if a skier slips off and goes too low in the traverses, he'll lose precious seconds."

As you look to your future course, watch for the company whose progress is on a time line with your own.

Ask companies about their expansion and modernization programs (ours is an optimistic $221 million). Find out if you're interested in the markets they're interested in. If they have a position that fits the course you've set. If they promote from within.

Don't settle for salary and status quo. We don't. Pick a time at your college placement office. Let's discuss your future. The Timken Company, Canton, Ohio 44706.

Timken® bearings are sold all over the world. Manufacturing in Australia, Brazil, Canada, England, France, South Africa and the U.S.A.

An Equal Opportunity Employer (m/f).

On your campus...

February 8, 1971

A Timken Company representative would like to talk with you!

TIMKEN®

REGISTERED TRADEMARK

THE TIMKEN COMPANY MANUFACTURES TAPERED ROLLER BEARINGS, FINE ALLOY STEEL AND REMOVABLE ROCK BITS.

Light at the End of the Tunnel

by Rodger Whipple

This article is designed to acquaint I.T. students with the work of C.E. professor Don Yardley and the interest he and his students have in tunneling for parking and transit. It also encourages them to work with him on a total solution to mass transit problems.

The article is based on an interview with Dr. Yardley and Dr. Nelson, and the Transit Commission's Administrative Assistant.

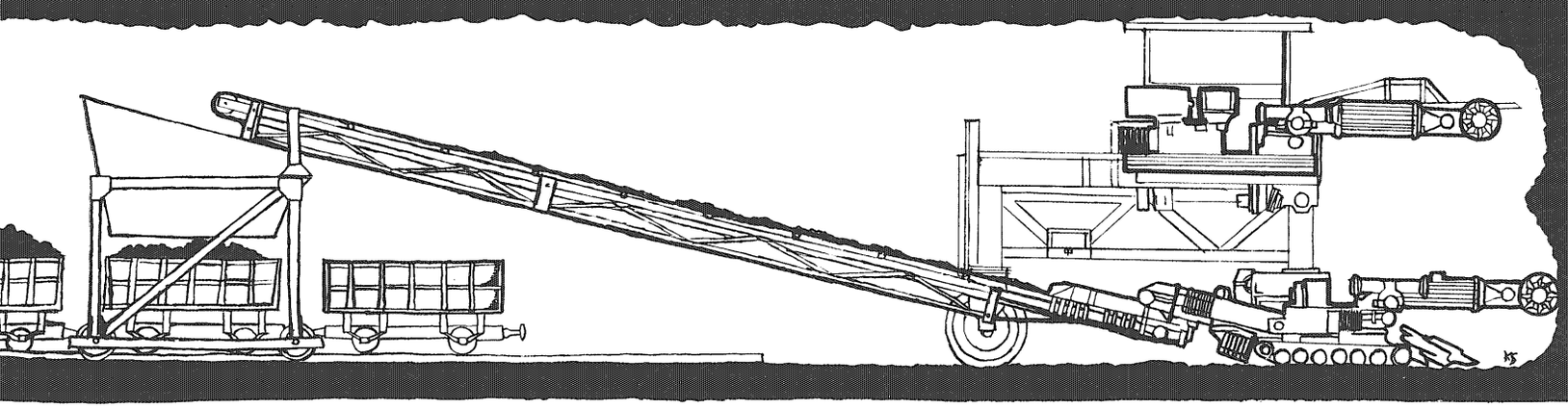
"They don't know their asses from a hole in the ground." Dr. Don Yardley sat with his feet propped up on his desk as he grumbled about transit planners and their lack of interest in tunneling. "They only think in two dimensional terms," he went on. They completely ignore the third dimension —all that lies below the surface."

Yardley and a number of his colleagues advocate using a unique feature of Minnesota geology to solve the Twin Cities' transportation and parking problems. A layer of sandstone, specifically St. Peter Sandstone, which lies under most of the metropolitan area, easily excavates for structurally self-supporting tunnels. This layer averages 150 feet in thickness and lies relatively close to the surface is most sections. Using the St. Peter Sandstone for tunnels is not a new concept; since the 1880's, tunnels have been excavated for sewer and utility lines.

In many places along the Mississippi River and along Minnehaha Creek, the sandstone layer is exposed to the elements and man. Simple abrasive motions across the surface wear the sand away, which leads passersby to carve names and designs into the stone.

Yardley explained how he first thought of the idea of using the St. Peter Sandstone for transit. Someone took my parking space, so I had to park down on the river flats." This was in the days before the parking ramp was constructed behind Coffman Union, and he had a lot of steps to climb on a cold winter's day. "I thought how simple it would be to push a tunnel into the sandstone from the river flats to wherever you wanted beneath the campus." The tunnel would be naturally temperate and elevators could lift passengers to the surface.

It was a simple expansion of this idea that led to his present idea of using the sandstone layer for parking and, ultimately, transit. For the parking concept, Yardley and his students, with no funds available to them, have amassed material to show their idea's feasibility. He shuffled through the clutter of papers and books on his desk in a useless attempt to document that claim with the actual reports.



Cross-sectional Schematic of Working Alpine-miner

The idea is similar for mass transit tunnels. Settling back in his chair, he continued, "There isn't any problem that we don't have the technology for. Here in the Twin Cities, we have a relatively beautiful situation. We can construct the tunnels, with a lining, using the present technology." He continually claimed no technical problems exist in excavating the sandstone.

The studies that Dr. Yardley, his associates, and students have made, point toward the construction of twin tubes between the Minneapolis and St. Paul campuses. For a design project, a student did a preliminary analysis of the problem. "He estimated the cost at $10 million for three miles," said Dr. Yardley after making another fruitless shuffle through the clutter. No system recommendations have been made for transit in the tunnels, although Yardley first envisioned the tunnels for vehicular traffic.

"Most people don't realize that there is a lot of tunneling expertise centered right here in the cities." He rattled off the names of two companies, Al Johnson Co. and Winston Bros. and the names of tunneling authorities, Dr. Charles Fairhurst, Professor Eugene Pfleider, Dr. John Hanley and Dr. Charles Nelson, who was also seated in the room, hardly able to add more than a word or two in the rush of Dr. Yardley's enthusiasm. "So we know what we're talking about when we say it is technically feasible."

Feasibility

Technical feasibility is important, but so are cost considerations. The Metropolitan Transit Commission, in *Status Report: Transit Program for the Twin Cities Area,* published in August 1970, says, "An extensive network of elevated guideways (as part of one considered system) would be objectionable to the community, but extremely costly if built underground."

Dr. Yardley replied, "We estimate the cost for a fifteen foot (diameter) tunnel, including a one foot (thick) lining, to be about $260 per foot (penetration distance)." That works out to be about $1.3 million a mile. He enumerated other advantages in the tunneling concept that would reduce system cost: elimination of weather effects, the ability to build in a straight line, the elimination of visual blight, and reduction of land purchase costs.

As Dr. Yardley and Dr. Nelson talked about the problem of excavating and constructing the lining, Dr. Nelson's specialty, it became apparent that a number of options exist which might help reduce or at least maintain tunneling costs over a period of years. Machines such as the Alpine-miner, and inovations such as spraying concrete on the walls might help to keep costs down while letting work proceed at 60 feet a day.

However, if the tunnel suggestion is the panacea for transit problems that it appears, why isn't the Metropolitan Transit Commission more interested in it? Basically, the commission is not yet willing to commit itself to a particular transit solution before it knows what effects transit will have on various segments of the community. Thus it has developed what it calls the family of vehicles concept. At the heart of this is the recently purchased Twin City Lines, which is now run by the commission with the help of a management firm.

This bus service will be modernized and will exist as a local or feeder system for express buses, like the university expresses, and for a rapid transit system for the high volume corridors. The total system will also be served and augmented by a small system which moves people within high activity centers such as the central business districts.

Long Range Goal

This then is the Transit Commission's long range goal for Twin City transit, yet the rapid transit system is the only place for Dr. Yardley's ideas. However, because the study done by the consulting firm of A. M. Voorhees and Associates did not receive much praise from metropolitan residents and observers, the Transit Commission is reticent about discussing what final form the rapid transit system will take.

Dr. Yardley and his associates are painfully aware of the lack of publicity and financial support their concept has. He was most anxious to have students, other than geological engineers, work on developing the total system. Yet, in spite of these problems, he is firm in his conviction that tunneling is the best and least expensive method for laying out transit lines. 'If we wanted to, we could have the contracts ready for bid in a month. After all, we work with tunnels every day." ◻

A more indepth discussion of the geology beneath the Twin Cities and Minnesota is offered on page 12, in an article titled, "Engineering Geology Aspects, Minneapolis-St. Paul Metropolitan Area." At the end of the article, on page 18, there is a list of additional geological references for further reading.

LOG'S LOG

by Ace & Zeus

INTRODUCTION: Since the E-F Team finally has run out of witty sayings, we can only greet you with this: "SALAMAT!". For a literal translation, see your lab TA. About 90% of you should receive the correct answer. The other 10% should consider themselves extremely fortunate!

Lush's Corner

Welcome back! Last month we introduced you to our source of little goodies to keep the night's a bit warmer (if you've nothing else)—Brucie's Bar and Body Shop. Since his concoctions are now world famous, The E-Force sent our liberal faction (abbreviated E.L.F.) out to test our readers acceptance. After several crushed fingers and toes, (and seven stitches from a guy who had his own way of expressing his appreciation), the ELF decided we needed a more scientific approach to our problem.

We took a sample of Brucie's latest to the Toime Testing Ground and Laboratory, which is located 1.43746 miles directly west of East Caledonia. Their lab report follows.

> Dear Sirs:
> The sample of "Slung Log" that you sent us was a very poor joke. We don't appreciate such low opinions of our capabilities! Any further samples of such quality will be referred to the Caledonia Sewage Disposal Plant.
> The T.T.G. & L.
> P.S. By the way, your bull has diabetes!

Having received approval of this month's selection, Zeus and Ace now present "Slung Log". Mix together 2 tablespoons of sugar in as much lemon juice. When the sugar is dissolved, add 2 ounces of **Sloe gin** and ½ ounce of cherry brandy. Fill the glass (12 oz. type) with ice and as much lemon lime soda as possible. Cheers!

Ace's Advice for the Month

One of my resolutions for this new year is to try to relieve some of the pain in the posterior caused by any lab, whether it be physics, chemistry, EE, IE, ME, or whatever disease you are currently inflicted with. Since Ace doesn't have the power to excuse anyone from these infernos, my only alternative is to furnish you with a set of helpful hints. I will do this by officially presenting to the world a set of guidelines hereafter to be called "Ace's Laws". The unique thing about my laws is that the formulater of them has an IQ equivalent to the profs who set up the damned experiments! (i.e. LOW). Memorize them or keep a copy nearby and you will surely pass—cough, cough!

Laws of Experiment

First Law——If anything can go wrong with an experiment, it will.
Second Law—Everything will go wrong at once.
Third Law—Experiments should be reproducible; that is, they should fail in exactly the same way everytime.

Rules of Experimental Procedure

Rule One——A detailed comprehensive record of data is useful; it indicates you must have been very busy.
Rule Two——Where graphs are required, draw your curves first and then plot your data.
Rule Three—Do not believe in luck. RELY ON IT!

Laws of the Universal Perversity of Matter

First Law——Any mechanical or electrical device is most likely to fail on the day following expiration of the guarantee.
Second Law—Any mechanism with any malfunction short of complete breakdown will operate perfectly in the presence of a trained serviceman or TA.
Third Law—Matter will always be damaged in direct proportion to its value.

Cor. 1. If a mechanism is accidentally dropped, it will fall in such a way that maximum damage will occur.

Cor. 2. Two things dropped at the same time will fall at right angles to each other. Any attempt to catch both will only result in missing both.

CONCLUSION: In order to expand the sporty knowledge of the E-Force, and to take advantage of our winter wonderland (likened to a perpetual cold shower), Ace and Zeus discovered that brave new rage—skiing. After being fitted with the essentials (skis, poles, goggles, and flight insurance) we set out to accost the slopes—or was it nopes?

Ace, being basically cowardly, permitted (forced) Zeus to lead the way. So with a pat on the back Zeus was on his way, except for one minor detail—no one told him to keep his eyes open. Needless to say, Zeus met up with a rather abrupt unanticipated stop. The snowbank was soft, however, and so was the girl in the snowbank. Now we know why skiing is so popular! All was about to be well, until we noticed we weren't alone. The little yellow cross and the letters S-K-I P-A-T-R-O-L told us it was time to move on. Besides, he was 6'9" and 346.12 lbs.

This all goes to show
There's a lot more to skiing than snow.
But we'll never know!

If you are a senior...

1971

could be the most important year of your life.

As you contemplate one of the most important decisions of your life, you will want to remember this: it is not just "a job" you are seeking—it should be the beginning of a career. And if it is to be successful, both you and your employer must need and want each other.

To help you with your decision, we invite you to consider the opportunities at Pratt & Whitney Aircraft. Currently, our engineers and scientists are exploring the ever-broadening avenues of energy conversion for every environment . . . all opening up new avenues of exploration in every field of aerospace, marine and industrial power application. The technical staff working on these programs, backed by Management's determination to provide the best and most advanced facilities and scientific apparatus, has already given the Company a firm foothold in the current land, sea, air and space programs so vital to our country's future.

We select our engineers and scientists carefully. Motivate them well. Give them the equipment and facilities only a leader can provide. Offer them company-paid, graduate-education opportunities. Encourage them to push into fields that have not been explored before. Keep them reaching for a little bit more responsibility than they can manage. Reward them well when they *do* manage it.

Your degree can be a B.S., M.S., or Ph.D. in: MECHANICAL ENGINEERING • AERONAUTICAL ENGINEERING • ENGINEERING SCIENCE • ENGINEERING MECHANICS.

If your degree is in another field, consult your college placement officer—or write Mr. Len Black. Engineering Department, Pratt & Whitney Aircraft, East Hartford, Connecticut 06108.

Pratt & Whitney Aircraft

EAST HARTFORD AND MIDDLETOWN, CONNECTICUT

U A

DIVISION OF UNITED AIRCRAFT CORPORATION

An Equal Opportunity Employer

Engineering Geology Aspects:

Minneapolis-St. Paul Metropolitan Area

by Robert E. Pendergast

Robert E. Pendergast is a geological engineer (registered in Minnesota), employed by Twin City Testing and Engineering Laboratory, Inc., in St. Paul, Minnesota. He received his undergraduate education at Dartmouth College, majoring in geology. He attended the University of Minnesota graduate school, in geology and engineering. He has been with Twin City Testing for 11 years. He is the Supervisor of the Soil and Geological Engineering Department.

This paper was presented at the 1969 National Meeting of the Association of Engineering Geologists, which was held in San Francisco in October of 1969. The theme of the meeting was "Engineering Geology in the Urban Environment". Engineering geology is defined as the science and profession of geology as applied to engineering. The Association of Engineering Geologists is a 10 year old, international organization with a membership of about 2000—mostly in the United States.

Geography

The Minneapolis-St. Paul Metropolitan Area is comprised of seven counties, having an area of 2,820 square miles. The population is about 2 million—the Nation's 15th largest urban area. The projected population growth is 2½ per cent annually.

In common with all large urban centers, the Twin City Metropolitan Area has land-use problems that cross municipal boundaries and have area-wide effect. A governing body, the Metropolitan Council, recently has been established to control such matters. The council consists of a board whose members are appointed by the Governor to serve on a term basis and a full-time professional staff.

Bedrock Geology

The metropolitan area is underlain by a gently warped basin of Paleozoic sedimentary strata. The basin lies above a thick succession of basalts and sedimentary rocks of late Precambrian age. The basalts and associated sedimentary strata constitute the Midcontinent Gravity High. The Midcontinent Gravity High is a long narrow zone of anamalously high gravity. It is a synclinal structure, extending from Lake Superior to Kansas. The structure has been uplifted along border faults to form a horst. The faults that bound the horst extend upward through overlying Paleozoic sedimentary rocks. The metropolitan area is a region of very low seismic activity, which is favorable for building design and construction costs, notably for nuclear power generating plants.

The Precambrian basalts and sandstones are underlain by the older Precambrian basement rocks, and overlain by Precambrian, Cambrian and Ordovician sandstones, shales and limestones. A geologic cross-section through the area and the stratigraphic column is shown in Figure 1.

The sedimentary formations in the Twin City area have many uses:

The Jordan sandstone is an important aquifer, and also is used for frac sand in petroleum production.

The Prairie du Chien dolomite group is a source of crushed rock aggregate.

The St. Peter Sandstone has the important property of being easily excavated, commonly by manually directed, high pressure water jets. Because of this property, the sandstone is used extensively for utility line tunnels. The tunnels generally are self-supporting, though a simple system of ring beams and wood lagging is used for extra safety during construction. It has been proposed to utilize the formation for underground parking and vehicular traffic tunnels. The St. Peter sandstone also has been used extensively for the manufacture of glass.

The most important use of the Platteville limestone is as a founda-

tion bearing material in downtown Minneapolis and St. Paul. Depending on the depth to rock, either normal spread footings or caissons are used. Typically, the upper surface of the limestone is weathered to a depth of as much as 5 ft. The underlying unweathered rock is quite competent, with typical core recoveries of 90 to 100 per cent. Design bearing capacities of as much as 50 tons per square foot are used on the unweathered rock. In downtown St. Paul, caisson foundations are also used on the St. Peter sandstone and the Decorah shale, with loadings of about 15 tons per square foot. Virtually no core recovery can be obtained in either of these rocks, though the standard penetration resistance is on the order of 0.2 ft per 100 blows.

A notable feature in the area is a series of bedrock valleys that were formed by Pleistocene and present rivers. Some of the valleys are shown in Figure 1. The Pleistocene valleys have been filled with drift and alluvium, and they generally are not recognizable from the surface, although some are overlain with chains-of-lakes. The alluvium contains weak cohesive soils and backwater organic deposits that present substantial foundation problems. For this reason, pile foundations generally are used in these valleys.

Soil Geology

The bedrock of the area is overlain by deposits of drift and alluvium of variable thickness, as can be seen in Figure 1. The surface topography is quite variable, ranging from hilly end moraines and pitted outwash plains to flat ground moraines, alluvial terraces, and normal outwash plains.

The glacial drift exposed in the area was left by two glaciers, the deposits of which have distinctly different properties. Drift exposed in the eastern part of the area was deposited by the Superior Lobe, which came from the Patrician glacial center in Canada, northeast of the area. The till is red and sandy, and the outwash is characterized by particles of red sandstone and igneous rocks. Drift exposed in the western part of the area was deposited by the Des Moines Lobe, which came from the Keewatin glacial center in Canada, northwest of the area. This drift is gray and clayey, and the outwash is characterized by the presence of limestone and shale.

There are two recently published maps of the soils in the area: (1) a reconnaissance geologic map of the surficial deposits (Stone, 1966), and (2) a map of soils prepared specifically for urban purposes (Hanson, et al, 1967). On the latter, the soils have been classified into groups based on the combined effect of drainage characteristics, texture, and slope. Through study of the two maps, I have correlated the soil groups with the geologic deposits (Table I).

In a recent publication (Borchert and Yaeger, 1969), there are maps showing the urban growth pattern, including the location of built-up areas, at time intervals between 1874 and 1964. There are also contour maps showing family income for the years 1950 to 1960. Comparison of these maps with surface topography maps discloses that: (1) Urban development has changed with time from being in predominantly flat areas to being in hilly areas, and (2) there is a definite trend for higher income families to live in hilly areas. This study confirms an expected relationship, namely, that with increasing population, suburbanization, and affluence, the higher cost homes tend to be constructed in the hilly areas that provide scenery and seclusion.

Construction costs are higher, however, because of grade leveling and problems with swamp deposits and pockets of soft, cohesive outwash in the terminal moraines.

Water Resources

The water resources of the area are plentiful and constitute one of its greatest assets. There are more than 400 lakes and three major rivers, the Minnesota, Mississippi, and St. Croix, in the area. These water bodies are used for recreation and commerce, as well as for water supply. The Mississippi River provides water for the municipalities of Minneapolis and St. Paul. St. Paul also obtains water from one of the chain-of-lakes. Most individual domestic supplies are from wells in glacial drift. The basin-shaped structure of the sedimentary rocks beneath the Metropolitan Area provides ideal conditions for artesian water supplies. The bedrock aquifers provide most sources for individual industrial wells and for suburban towns. Although clean water sources are plentiful, there is concern about depletion and pollution with growing population and industrialization (Minnesota Conservation Department, 1961).

Aggregate Resources

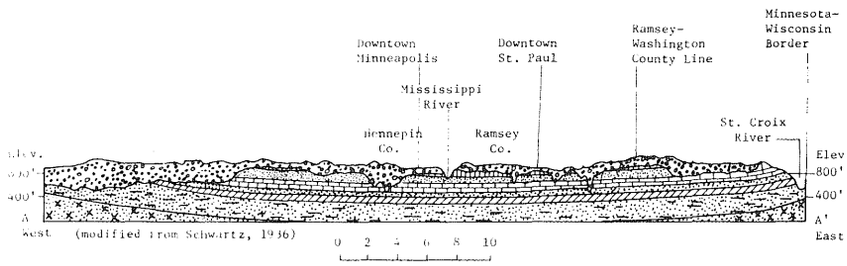
Crushed limestone and sand-gravel deposits are mined for use as aggregate. The supplies are plentiful, although problems are developing with

[Continued on page 17]

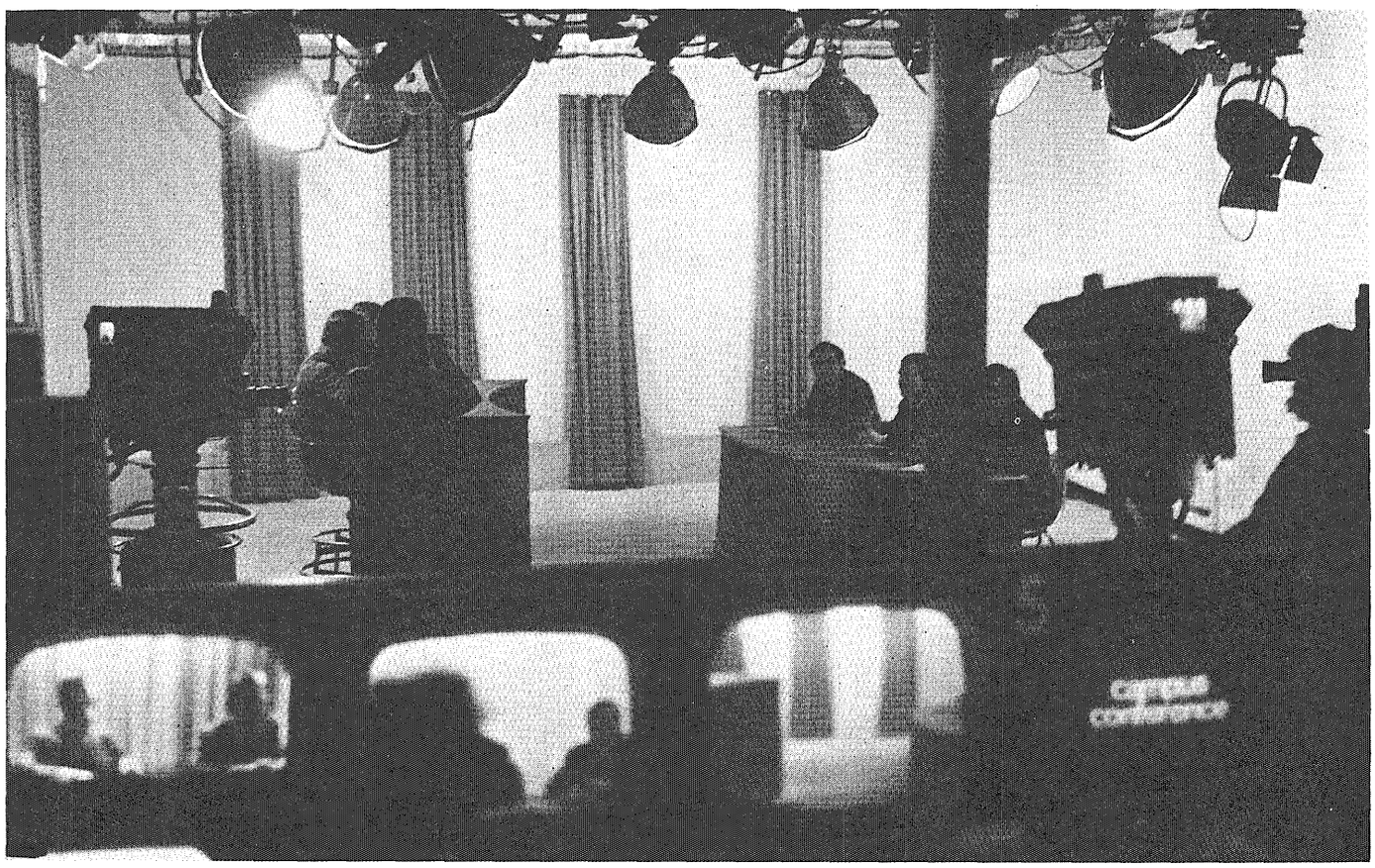
FIGURE 1

GEOLOGIC CROSS-SECTION AND STRATIGRAPHIC COLUMN

MINNEAPOLIS-ST. PAUL METROPOLITAN AREA



Age	Stratigraphy
Pleistocene & Recent	Glacial deposits & alluvium
Ordovician	Decorah shale (not in cross-section - sparse distribution)
Ordovician	Platteville limestone
Ordovician	St. Peter sandstone
Ordovician	Prairie du Chien dolomite
Cambrian	Jordan sandstone
Cambrian	St. Lawrence dolomite
Cambrian	Sandstones & shales
Precambrian	Sandstones & basalts



The program "Campus Conference" is about to begin in one of the two TV filming studios located in Eddy Hall.

INTRODUCING . . .

U OF M

DEPARTMENT OF RADIO AND TELEVISION

by John McFeters

photos by Ron Reichenberger

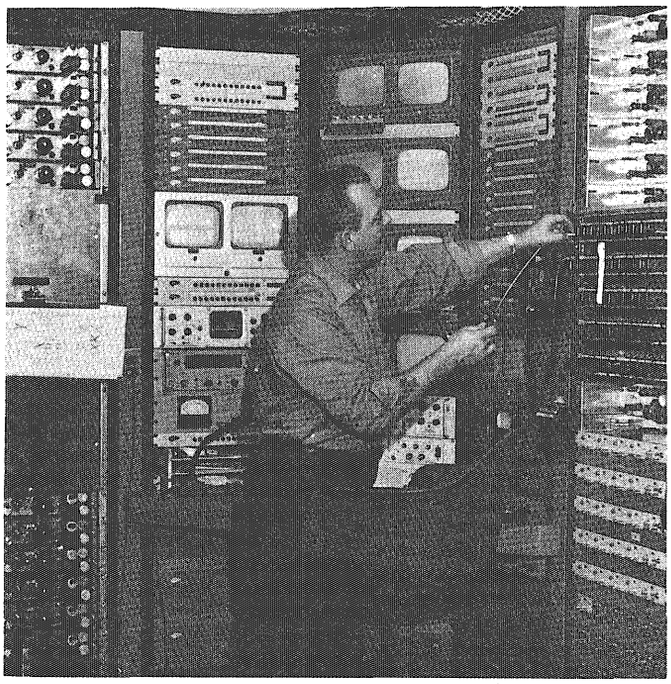
Hidden away in the basement of Eddy Hall on the Minneapolis campus of the University of Minnesota is the U of M's Department of Radio and Television. Through its radio station, "School of the Air," KUOM, and closed circuit television and film production a large audience of students, faculty and general public is served.

The television portion of the department handles all of the closed circuit television productions shown in classrooms throughout campus. The TV staff also supervised the University of Minnesota's television programs on educational station, KTCA, channel 2.

Facilities for production of closed circuit film include two complete TV filming studios in which all University closed circuit materials are produced, including all of those wonderful early morning TV lectures. To relay these films through the circuits to the correct classroom there is a complex system of monitors and video tape playback machines manned by a staff of professional television engineers.

The TV studios are also used as speech laboratories for students studying TV production in speech classes.

The second major part of the department is the radio station, KUOM, called the "School of the Air." First operation of the station began in 1938, and in 1946 the present director, Betty Girling, took control. Since then, KUOM has served public school students in Southeastern Minnesota and Western Wisconsin. Programming of the "School of the Air" is mainly directed at elementary school students in this area as an aid and supplement to their teachers.



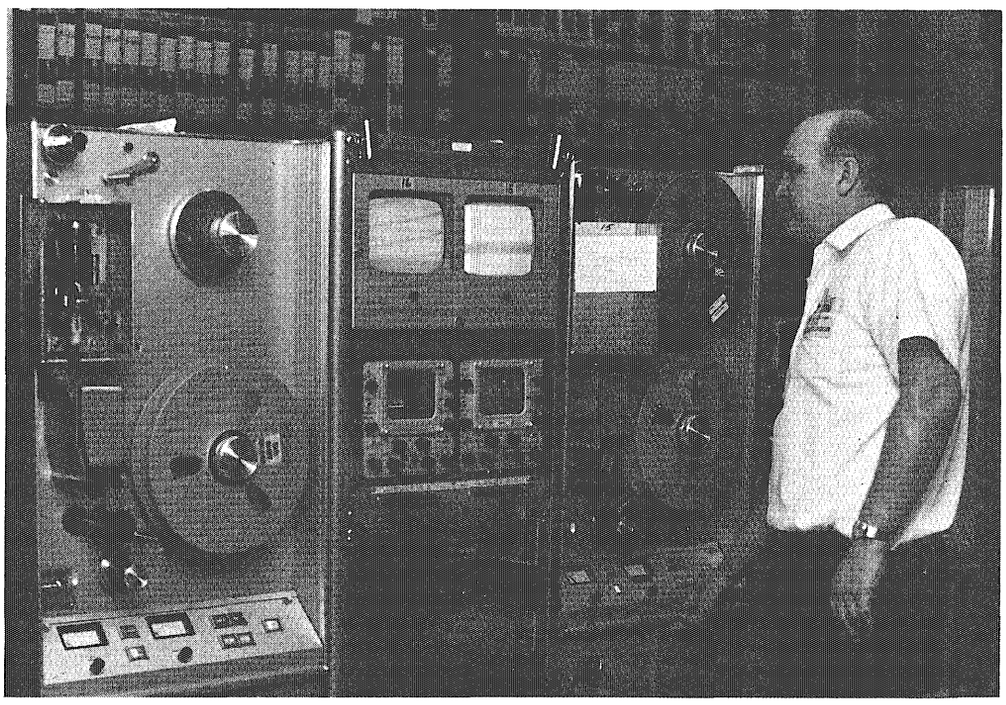
An engineer connects the necessary circuits to send the correct program to the proper room.

A technician attempts to locate a problem in a TV camera.

A wide variety of programs ranging from musical introductions to music originally composed for the "School," to biographical sketches of prominent but relatively unknown men and women in history are broadcast daily. The ordinary, stereotype children's shows are avoided.

Broadcast staff of the "School" consists of professional and semi-professional performers. Using the talents of these people enables the normally dry-type educational programs to become lively, interesting and entertaining to young listeners.

The "School of the Air" also has a tape service for supplying tape recordings of broadcasts to teachers upon request. The tapes are recorded at no cost, except for materials, by the State Department of Education and the Audio Visual Service of the University.



An engineer reviews a program previously recorded.

What's New

...in Science and Engineering

Anti-Stat Drafting Film

A totally new Anti-Stat Drafting Film has been introduced by Eugene Dietzgen Company offering greater dirt repellency and better machine separation. The new material is available in all standard size sheets and rolls at no increase in cost over conventional polyester drafting film.

Dietzgen developed a unique treatment for drafting film to end the problems of static electricity build up and its resulting problems. Room dust, eraser particles, lint and other foreign materials in the air tend to be attracted to untreated polyester drafting film, particularly under low humidity conditions which are conducive to electro-static buildup.

The new Dietzgen Anti-Stat film, in laboratory testing, provided superior dirt repellency and better separation in reproduction machines over a wide range of temperature and humidity conditions.

In the production of Anti-Stat Drafting Film, a final coating is applied to the film to eliminate static build up.

Computerized Drafting

What happened to the old drawing board? Technical aids at Reliance Electric Company, Cleveland, do the work of seven skilled draftsmen thanks to a new, automated, computerized drafting system. They simply point to or type the raw data required for a finished engineering drawing and a computer takes over from there. The computer organizes the information and prepares instructions for a photo-electronic device, which produces the finished drawing in five minutes.

Fiber Glass

People in glass houses should not throw stones, especially if they are in a twenty-thousand-mile orbit. Future space stations, as well as more down-to-earth airplanes, may be constructed of fiber glass, instead of metal alloys.

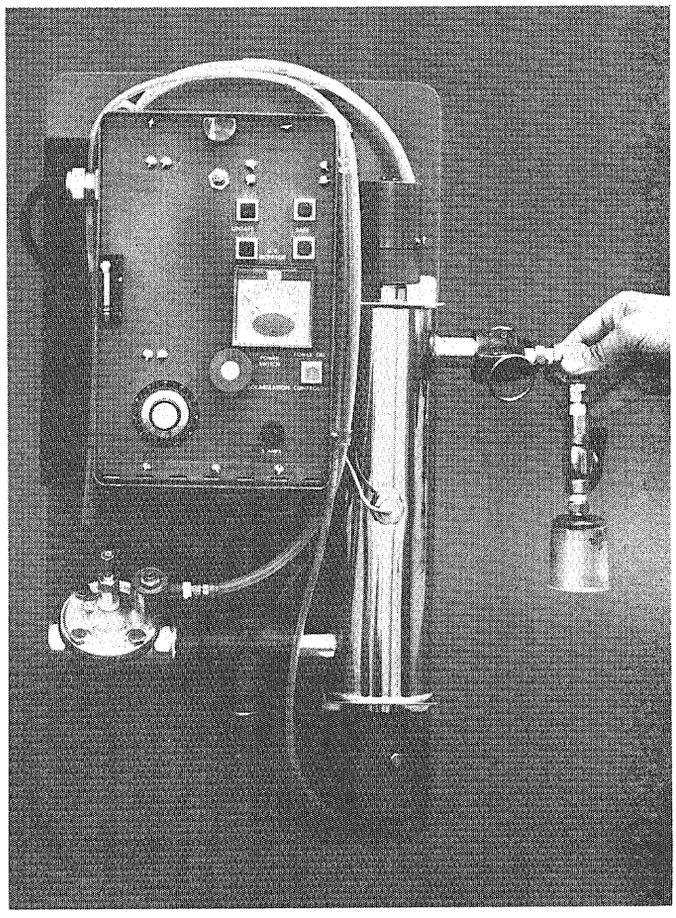
The present weakness of fiber glass is that existing compositions are still less rigid than their steel counterparts. If the elastic stiffness of the individual glass fibers could be increased, the advantage would be significant.

Before the glass fibers can be stiffened, there must more information on the basic properties of glass. High silica glass cannot withstand high strain because water attacks the surface and weakens the glass. Under the extremely cold temperatures of liquid nitrogen, however, this glass can be put under a greater strain than normally possible (up to 12 percent more). Under the increased strain, the high-silica-content glass exhibits a modulus of elasticity (that is, stiffness) twice that obtained at ordinary strains. The understanding of this property of the glass would permit more precise attempts to predict and thereby increase the strength and rigidity of glass fibers.

This promise of fiber glass having high stiffness, as well as a strength-to-weight ratio three times that of steel, indicates a future trend toward fiber glass in aerodynamic construction. There already exist prototype fiber glass planes, and applications have reached as far as the space program.

Aseptoline

Foremost Water Systems' Aseptoline is a self-monitoring, fail-safe ultraviolet unit that delivers sterile water when used in conjunction with deionization or distillation systems. The unit, as shown here, is covered by



an easily-cleaned cabinet with an electrical interlock switch and key lock to prevent tampering and leaves visible only the control signals, monitoring meter and power switch. Dimensions of the Aseptoline unit are 14 ½" × 23 ⅝" × 5 ½".

[Continued from page 13]

respect to construction of buildings and highways over potential source areas. Improved zoning ordinances are needed to remedy this situation (Hogberg, 1966).

An unusual feature of some of the sand and gravel deposits is the presence of highly silicious shale particles which cause surface pop-outs in Portland cement concrete. The shale, which is derived from Cretaceous sediments in North Dakota and Canada, is unusual in that it is composed almost solely of silica. The silica is in the form of opal and chrystobalite. The shale was brought into the area by the Des Moines Lobe, and thus the deposits are restricted to Des Moines outwash. This is of importance with respect to exploration and development of deposits.

The pop-outs are small, inverted, cone-shaped pieces which spall from the surface of concrete slabs-on-grade. The pop-outs cause an unslightly and rough surface on the slabs. The apex of each pop-out contains a small piece of shale. When the plastic concrete is placed and vibrated, the shale particles float upward toward the surface. During periods of high temperature, the silica and the alkalis (potassium oxide and/or sodium oxide) in the Portland cement react in the presence of water; water is imbibed, and a silicate gel is formed. This expands and forces out the overlying concrete. The problem can be alleviated by various means, such as removing the shale from the aggregate, use of low alkali content cement, and use of special curing procedures.

[Further suggested readings on page 18]

Soil Group (From Map of Soils for Urban Purposes)	Geologic Deposit (From Geologic Map of Surficial Deposits)
1	Superior outwash, Des Moines outwash, valley train, alluvium
2	Superior outwash
3	Des Moines outwash, Superior till?
4	Des Moines till, Superior till
5	Des Moines till, Superior till
6	Des Moines outwash, alluvium
7	Lake deposits
8	Bedrock

Table 1

(Continued from page 18)

SELECTED REFERENCES

GENERAL

Anonymous, "Government; Minnesota Model" *Time*, Sept. 19, 1969, p. 64-65 (Regarding Metropolitan Council).

Borchert, John R., and Yaeger, Donald P., "Atlas of Minnesota Resources and Settlement," Minnesota State Planning Agency, 1968, revised 1969. (Available from Documents Section, 140 Centennial Building, St. Paul, Minnesota 55101.)

Schwartz, G. M., "The Geology of the Minneapolis-St. Paul Metropolitan Area," Minnesota Geological Survey Bulletin No. 27, 1936 (out of print).

BEDROCK GEOLOGY

Austin, George S., "Palezoic Stratigraphic Nomenclature for Southeastern Minnesota," Minnesota Geologic Survey, Information Circular 6, 1969.

Gardner, E. L., "Studies of Foundations in Shale, 11th SMFE,* 1963; (Studies of Glenwood shale, which is a 5 ft shale bed between the Plateville limestone and the St. Peter sandstone).

Leal, George D., "The Foundation Study for the Prairie Island Nuclear Generating Plant, 16th SMFE,* 1968 (seismic activity rating).

Lewis, Walter E., "Hydraulic Tunneling in St. Peter Sandstone at Minneapolis, Minnesota," U. S. Bureau of Mines Circular No. 7571, 1950.

McRae, Kermit K., "Minneapolis Storm Drain Tunnel Construction," 12th SMFE,* 1964 (St. Peter sandstone).

Ostrem, William A., "Design of Storm Sewer Tunnels in Minneapolis," 12th SMFE,* 1964 (St. Peter sandstone).

Payne, C. M., "Bedrock Geologic Map, Minneapolis-St. Paul and Vicinity," Minnesota Geological Survey Miscellaneous Map-1, 1965 (Scale 1:24,000).

Payne, C. M., "Engineering Aspects of the St. Peter Sandstone in the Minneapolis-St. Paul Area of Minnesota," M.S. Thesis, Geology Department, University of Arizona.

Sims, P. K., "Some Applications of Geology to Engineering Practice," 15th SMFE,* 1967 (St. Peter sandstone and Decorah shale).

Sims, P. K., and Zietz, Isidore, "Aeromagnetic and Inferred Precambrian Paleogeologic Map of Central Minnesota and Part of Wisconsin," U. S. Geological Survey, Geophysical Investigations Map, G.P.-563, 1967.

Yardley, D. H., "A Geological Engineering Analysis of Rock Failures in Two Engineering Projects," 13th SMFE,* 1965 (St. Peter sandstone).

SOIL GEOLOGY

Hanson, Lowell D., Springer, Celmet D., Farnum, Rouse S., Robertson, Alex S., Allred, Evan R., "Soils of the Twin Cities Metropolitan Area," University of Minnesota Extension Bulletin 320, 1967 (includes map of soils for urban purposes. Scale 1" = 2 miles).

Stone, J. E., "Reconnaissance Map of the Surficial Geology of the Minneapolis-St. Paul Area," Minnesota Geological Survey, 1966 (Scale: 1:250,000).

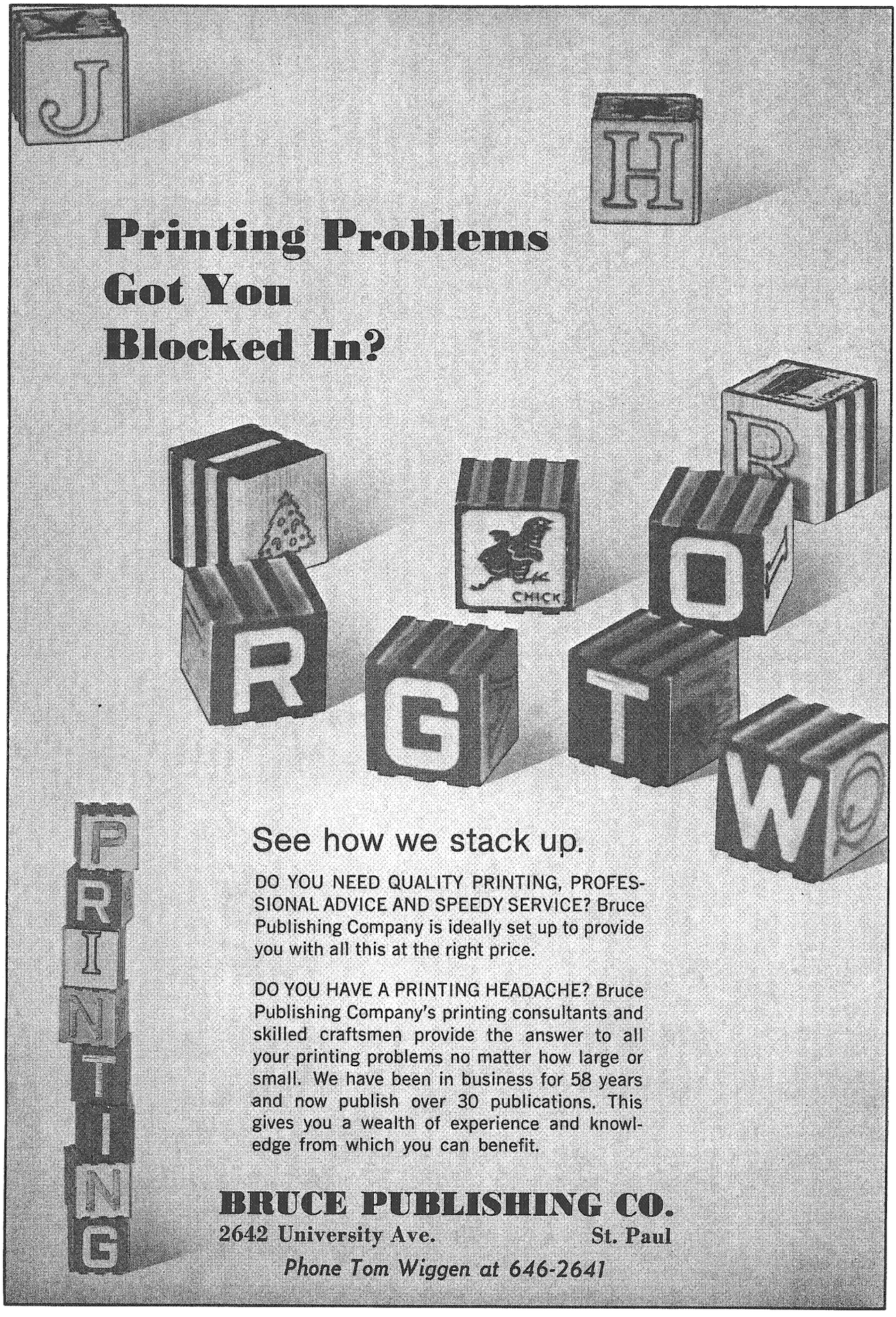
Wright, H. E., Jr., and Ruhe, R. V., "Quaternary of the United States: Glaciation in Minnesota ond Iowa," Princeton University Press, Princeton University, 1965.

WATER AND AGGREGATE RESOURCES

Conservation Department, State of Minnesota, Division of Waters, "Water Resources of the Minneapolis-St. Paul Metropolitan Area," Bulletin 11, 1961.

Hogberg, R. K., "Aggregate and Urban Growth, Southwest Part of Twin Cities," Seminar on Geology and Urban Growth, Twin Cities Metropolitan Area, 1966. (Available from Minnesota Geological Survey, University of Minnesota, Minneapolis, Minnesota.)

*Annual Conferences on Soils Mechanics and Foundation Engineering (available from the Center for Continuation Study, University of Minnesota, Minneapolis, Minnesota).


J
H
Printing Problems
Got You
Blocked In?
R
CHICK
G
T
R
O
W
P
R
I
N
T
I
N
G
See how we stack up.
DO YOU NEED QUALITY PRINTING, PROFESSIONAL ADVICE AND SPEEDY SERVICE? Bruce Publishing Company is ideally set up to provide you with all this at the right price.
DO YOU HAVE A PRINTING HEADACHE? Bruce Publishing Company's printing consultants and skilled craftsmen provide the answer to all your printing problems no matter how large or small. We have been in business for 58 years and now publish over 30 publications. This gives you a wealth of experience and knowledge from which you can benefit.
BRUCE PUBLISHING CO.
2642 University Ave. St. Paul
Phone Tom Wiggen at 646-2641

Splinters

—vilitas et crudas semper eternam

by BARRY JOHANSEN and RALPH POLKINGHORNE

The ski trooper had been in combat for 18 months. When he returned home on leave, he was interviewed.

Reporter: 'How does it feel to be home?"

Trooper: "Great, just great!"

Reporter: "What was the first thing you did when you came home?"

Trooper: "Well, I'm married, you know."

Reporter: "What was the second thing then?"

Trooper: "I took off my skis."

• • •

Definitions: Bra: A device used to minimize the effects of flutter and vibration, compensating for pitch and gyration.

Monastery: Home for un-wed fathers.

Ecstasy: Happens between Scotch and water and bacon and eggs.

• • •

Happiness is watching a drunk engineer trying to commit suicide as he jumps out of a window and lands on a beer truck.

• • •

Student Nurse: "Of all the remedies that won't cure a cold, whiskey is the most popular."

• • •

After picking up some eggs and catsup at the corner grocery, the young housewife stopped at a local bar to refresh her spirits. While inside, she dropped the groceries, creating a mess on the floor. A drunk walked over, surveyed the mess, and mumbled, 'Wouldn't have lived anyway, its eyes are too far apart."

• • •

Some coeds are like coffee; may be made instantly but prefer the regular grind.

• • •

"I just met a girl who is 52-24-36."

"What does she do?"

"Falls over a lot."

Indian Prof: "You missed my class yesterday, didn't you?"

E.E.: "No sir, not a bit."

• • •

We've often heard it said that gasoline and alcohol don't mix. The Chem E's tell us that they do, but it tastes lousy.

• • •

Most E.E.'s are more interested in frequency than high fidelity.

• • •

"Wait till you hear!" said one I.T. coed to another. "I went to the movies last night and I had to change my seat three times!"

"You mean you were actually molested?"

"Eventually," she said.

The ship was sinking and the captain announced that the men on board would have to relinquish their life preservers and give them to the women and children. The captain took his life jacket off, shouted, "God bless America," and jumped overboard.

A Frenchman followed him shouting "Vive la France."

At the sight of this, a large Texan threw a Mexican overboard and shouted "Remember the Alamo."

(It is rumored that an Indian was thrown off by a group of men shouting "Remember Math 23!")

• • •

"You'll be poor and unhappy until you graduate from college," said the fortune teller to the engineer.

"And then what?" asked the engineer hopefully.

"You'll be used to it by then," answered the fortune teller.

• • •

Psych Prof: "If I saw a man beating a mule and I stopped him, what would be my motivation?"

Voice in back of room: "Brotherly love."

Kodak

Chemical engineers should talk with us.

The new typesetting, for example. Microfilm. Every kind of image for the eye.

Here's why:

In photography, principal source of our business, our private language stems from chemical engineering. Chemical engineers therefore seem to learn it quickest. It's a good language to learn for an interesting, rewarding livelihood because Kodak photographic technology underlies much of today's communications, education, entertainment, and even medical care.

All rather fundamental.

Photography needs chemical engineers to manufacture its materials, to invent the next generation of them, to make customers appreciate them.

But photography is not our only business. This fact broadens the choice for the chemical engineer who seeks something closer to the environment pictured through the campus years invested in a professional education. That gives us our opening to talk about production, development, and marketing of our chemicals for industry and laboratory, our plastics, and our fibers.

Start the conversation with a note to
EASTMAN KODAK COMPANY
Business and Technical Personnel,
Rochester, N. Y. 14650

An equal-opportunity employer with major plants in Rochester, N. Y., Kingsport, Tenn., and Longview, Tex. and marketing activities almost everywhere.

Even if you don't like the air you breathe, you can't stop breathing.

When was the last time you went out for a breath of fresh air and got it? How long has it been since the sky looked really blue?

Every day, our cities dump hundreds of thousands of tons of waste into the air. Carbon monoxide. Sulfur dioxide. Fluoride compounds. And plain old soot.

If something isn't done about air pollution in your lifetime, it may cut your lifetime short.

Air pollution can be controlled. The key is technology. Technology and the engineers who can make it work.

Engineers at General Electric are working on the problem from several directions.

Rapid transit is one. In many cities, the automobile causes more than half the air pollution. In some cities, as much as 90%. But engineers at GE are designing new equipment for rapid-transit systems, encouraging more people to leave their cars in the garage.

Another direction is nuclear power. General Electric's engineers designed the very first nuclear power plant ever licensed. A nuclear plant produces electricity without producing smoke. And as the need for new power plants continues to grow, that will make a big difference.

There are other ways General Electric is fighting air pollution. Maybe you'd like to help. We could use your help. But don't expect to come up with an overnight solution to the problem.

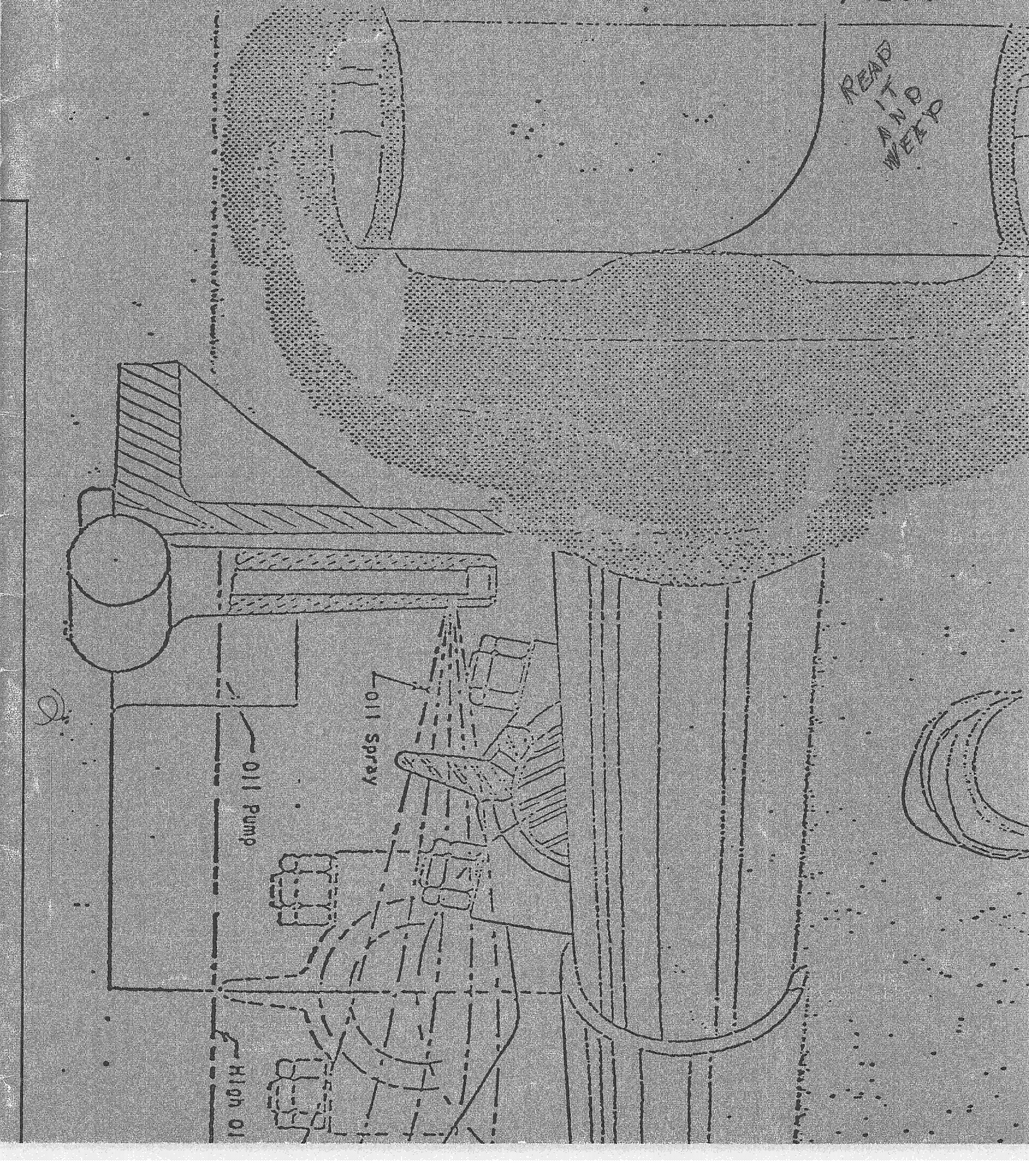
The solution will take a lot of people, a lot of talent and a lot of time. You'll breathe easier—once you get started.

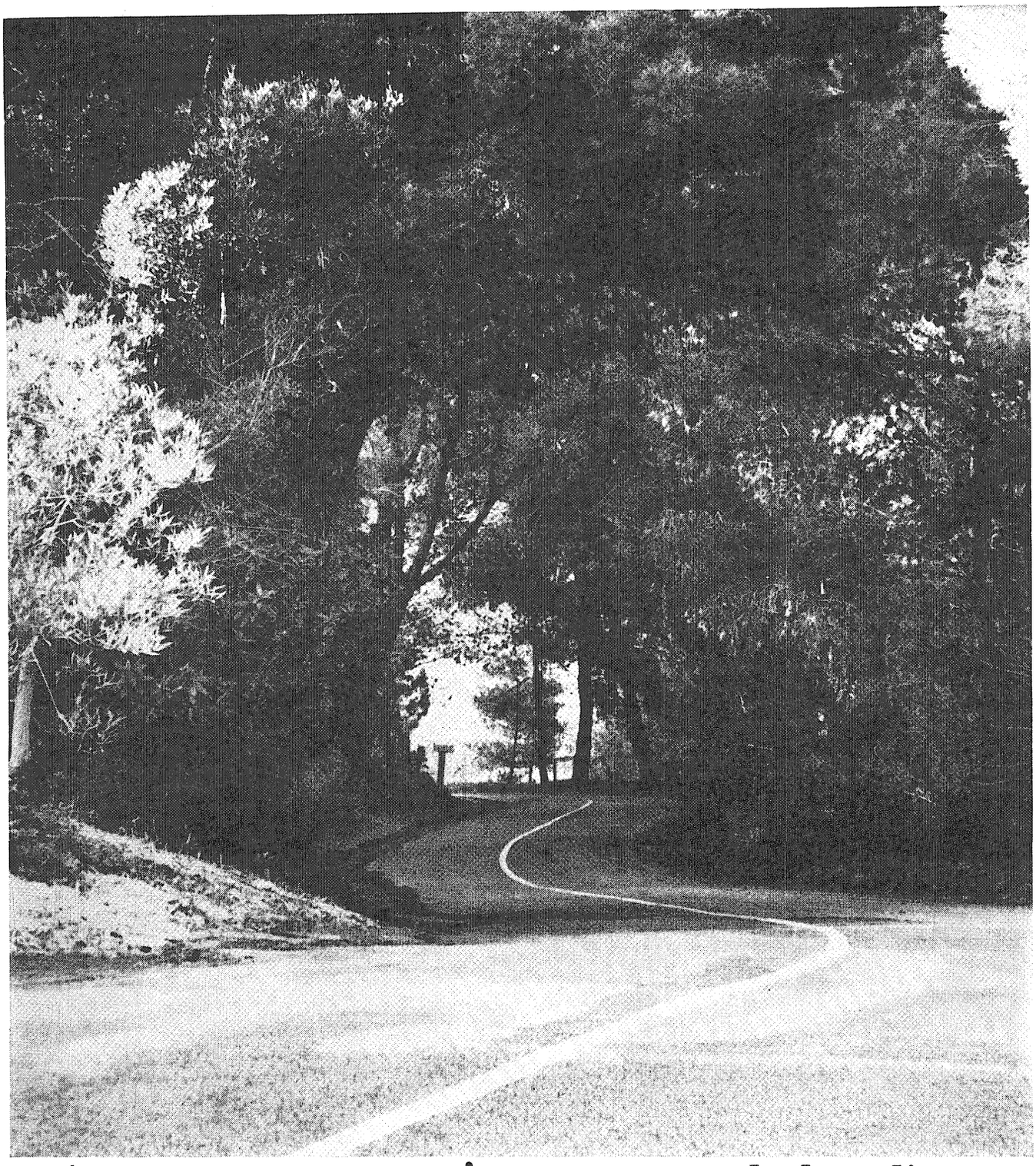
GENERAL ELECTRIC

An equal opportunity employer

TECHNOLOG

UNIVERSITY OF MINNESOTA FEBRUARY, 1971





As you can see, you can't see our new telephone lines.

They're underground.

We think America has enough eyesores, so wherever possible we're burying our new cable. And converting old aerial lines.

We already have over 50% of our lines underground. And before we're through we'll have about 92% buried.

We'll never reach 100% because in a few places it's practically impossible to get the cable underground. And in a few other places it's ridiculously expensive.

In the 15 years that we've been burying cable we've gone through hills and high water and turnpikes and mountains.

We've struck oil in Texas (a pipe in someone's backyard). And we've had to get a special repellent to keep gophers from eating the cable.

So if you still see a fair number of telephone poles around, bear with us. Our engineers are working as fast as they can to bury our lines.

And resurrect our scenery.

GTE

GENERAL TELEPHONE & ELECTRONICS

730 Third Ave., N.Y., N.Y. 10017

What I like about Celanese is the professional elbow room.

You had offers from other good companies. How did you come to pick Celanese?

There were a lot of reasons. One thing I liked—the recruiter I talked to was a Celanese project engineer, so he could tell me about the kinds of jobs I'd be working on.

How did you feel when you started?

Nervous! I was afraid of being stuck on one of those eternal company training programs. But at Celanese I was treated like a professional from the start. For a while, knowing that results were up to me was a little scary. But I found that when I needed help, it was right there.

You think that so much independence is a good thing?

It works. I think it's one reason why some basic ideas like epoxies, and an engineering resin—Celcon plastic—that's used to replace metals, and fibers like Fortrel polyester and Arnel triacetate all got their start at Celanese. A lot of new things are in the works, too. Right now I'm helping to scale up production of a composite material that will save weight in airplanes and rockets.

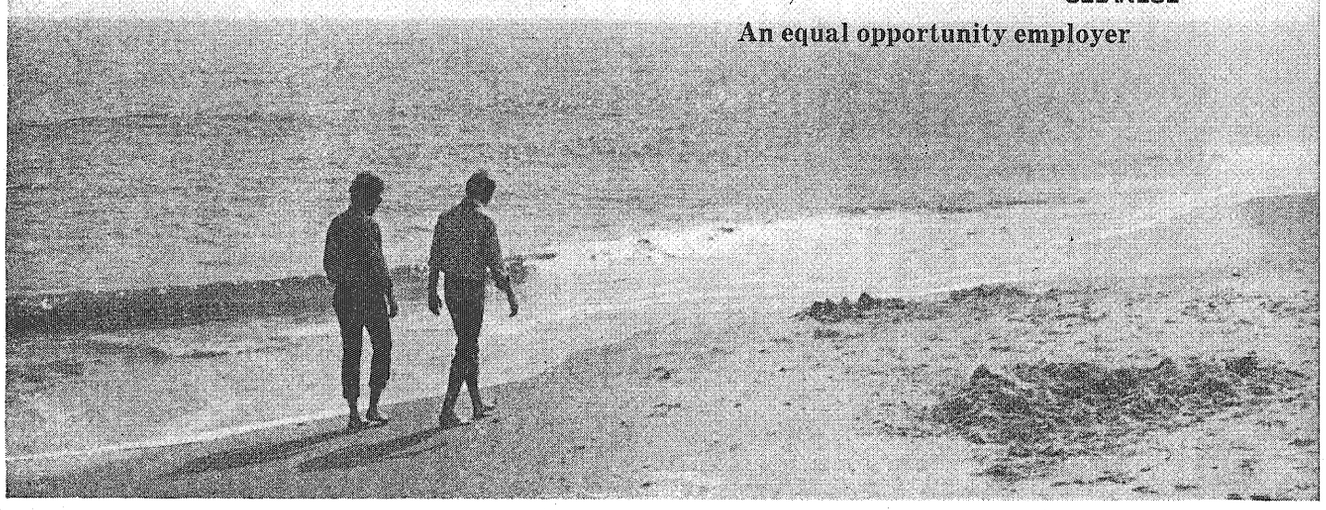
Expect to make a career with Celanese?

Who can say? All I know is I'm busy doing something worthwhile. I'm moving. I'm helping to make things happen.

Maybe Celanese is for you. If you have questions about how Celanese fits your plans for the future, have your placement office set up an interview. Or write to Dr. S. T. Clark, Celanese Corporation, 522 Fifth Avenue, New York, N.Y. 10036.

CELANESE®

An equal opportunity employer



ARNEL® AND CELCON® ARE TRADEMARKS OF CELANESE CORPORATION. FORTREL® IS A TRADEMARK OF FIBER INDUSTRIES, INC.

TECHNOLOG

VOL. 51, NO. 5 | Official Student Publication of the Institute of Technology, University of Minnesota | FEBRUARY 1971

FEATURES

DEPARTMENTS

THIS MONTH'S COVER is an original print which was created on an electrostatic copy machine. It is the subject of next month's feature article. Cover by Don Neal.

MEMBER OF ECMA

Published monthly, October through May. Second-class postage paid at Minneapolis, Minnesota. Office: Room 2, Mechanical Engineering Building, University of Minnesota, Minneapolis, Minnesota 55455. Telephone: 373-3298. Printer: Bruce Publishing Co., 2642 University Avenue, Saint Paul, Minnesota 55114. Publisher's National Representative: Littell-Murray-Barnhill, Inc., 369 Lexington Avenue, New York, New York 10017 and 737 North Michigan Avenue, Chicago, Illinois 60611. Publisher's State and Local Representative: University Engineering Magazine Advertising, F. P. McGrath Manager, Box 14026 University Station, Minneapolis, Minnesota. Telephone 612-225-0708. Member of the Engineering College Magazines Associated, Gordon Smith, Oklahoma State University, Stillwater, Oklahoma. Subscription rate: $4.00 per year, single copies 50 cents. Advertising rates upon request.

The New Center for Studies of the Physical Environment

by Rodger Whipple

"Within the past year, the attention of virtually all segments of society has focused on the interaction of man with his environment"

Environment is, literally, everything. It is an exceedingly complex and plastic whole which includes both everything known and everything unknown to man. Man has realized that he is but part of this larger whole, and that a complex system of mutual influence operates between the various parts of the total environment. These influences range in degree from the most trivial to the utterly profound. Man's increasing ability to effect rapid and large-scale change through his use of other environmental components has led many people to believe that it is imprudent and arrogant, if not dangerous, to exclude anything from the concept of environment.

In his attempt to understand what he perceives, man has divided the single environmental whole into increasingly smaller parts. This reductionist approach has fostered a high degree of specialization among scientists whose discipline channels them into the study of tiny environmental components. None of these parts exist in an isolated state; their relationship to, and interaction with, other parts of the environment can be no less important to their definition than the ascertainment of unique characteristics. Undoubtedly, both kinds of study are necessary and important. It would appear, however, that the study of the interaction of environmental components has been neglected, though not ignored, in favor of the study of isolated parts.

Compounding the difficulty of understanding the simple interactions or the complex chains of interactions which take place in the environment is the fact that the environment is dynamic; its components change incessantly in quantity and in kind with the passage of time. Stability, in terms of permanent forms or relationships, is neither possible nor desirable; the vitality and health of the environment is dependent upon dynamic diversity.

The Center is Formed . . .

"Within the past year, the attention of virtually all segments of society has focused on the interaction of man with his environment. It has become abundantly clear that a substantial deterioration of the quality of air, water, and many of the facets of urban life has occurred. The prognosis for the future unfortunately is that further

deterioration will occur; the most alarming aspect of the problem is that the rate of deterioration is seemingly increasing."

The opening lines of the proposal for the formation of an Institute of Technology (IT) Center for Studies of the Physical Environment state the problem succinctly. Beginning with the Board of Regents approval in Summer, 1970, the first purposeful steps toward contributing solutions are being taken. Richard Swalin, Associate Dean of the Institute of Technology and chairman of the pre-center Physical Environment Study Group, views the Center with delight, "We have high hopes for this Center. It is the wave of the future and is a departure for our institute because we will be concerned with the whole problem. But, to succeed, it must have faculty and student cooperation in devising courses and initiating multidisiplinary research."

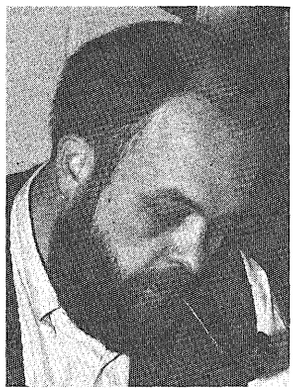
The Institute of Technology Center for Studies of the Physical Environment has existed since summer 1970 when the proposal for creation of the Center was approved by the Board of Regents. The proposal was formulated by a faculty committee which met during the 1969-1970 academic year as the Institute of Technology Physical Environment Study Group.

The director of the Center was selected in the fall of 1970 and his appointment approved by the Board of Regents in December 1970. Formulation and implementation of the Center's program, consistent with the guidelines set forth in the proposal for formation of the Center, began following the Regents approval of the director's appointment.

In addition to the director, reporting to the Dean of the Institute of Technology, an advisory committee has been appointed by the Dean. This committee presently consists of: John E. Anderson, Perry Blackshear, Arnold Frederickson, Stephen Kahne, Walter Maier, Bruce Nelson, Hans-Olaf Pfannkuch, Richard Skaggs, Richard Swalin, Val Woodward, William Zimmermann. The committee will be expanded as additional faculty members become active in the Center's activities and will include individuals from other collegiate units and possibly representatives from extra-University agencies with interest and responsibility directly related to the Center's activities.

The Environmental Study Group, an informal, ad-hoc, committee, was put together to look at what the Institute of Technology might do to coordinate activity, encourage study, and catalyze research. The committee members came from a variety of IT departments: The Hydrology Laboratory, Civil, Mechanical, Chemical, and Electrical Engineering, Geology, Limnalogy, and Architecture: and from two outside departments: The College of Biological Sciences and Political Science.

"Much of the solution is political," the proposal goes on. "That is to say, it appears that political action can have a very substantial influence on the course which our society takes and that new technologies, although useful, are not absolutely essential. Notwithstanding, we in the Institute of Technology have a very immediate concern with the problem. The decades of the fifties and sixties witnessed an unprecendented degree of technological innovations in the United States. This activity involved the participation of significant numbers who were educated in universities such as the University of Minnesota. All indications are that the quality of technical education is excellent. What has been generally missing, however, in the technical educational process is a concern for the social effects of technology."



Dr. Dean E. Abrahamson, Director of Center for Studies of the Physical Environment.

Implicit in the makeup of the study group was the assumption that any solutions to environmental problems would involve extending traditional academic boundaries, using the specialized talents each discipline offers but working together.

Dean Swalin emphasized that in additional environmental courses, "It's important to educate within the disciplines, but it should be possible for students to take courses concerned with environmental affairs. It's important that we train people with in-depth knowledge, but who have a sensitivity toward these large scale environmental problems. Partly in response to expanded relationships between engineering activities and such diverse activities as medicine, ecology, and poltical science, our undergraduate programs in various fields of en-

Environment Continued on page 28

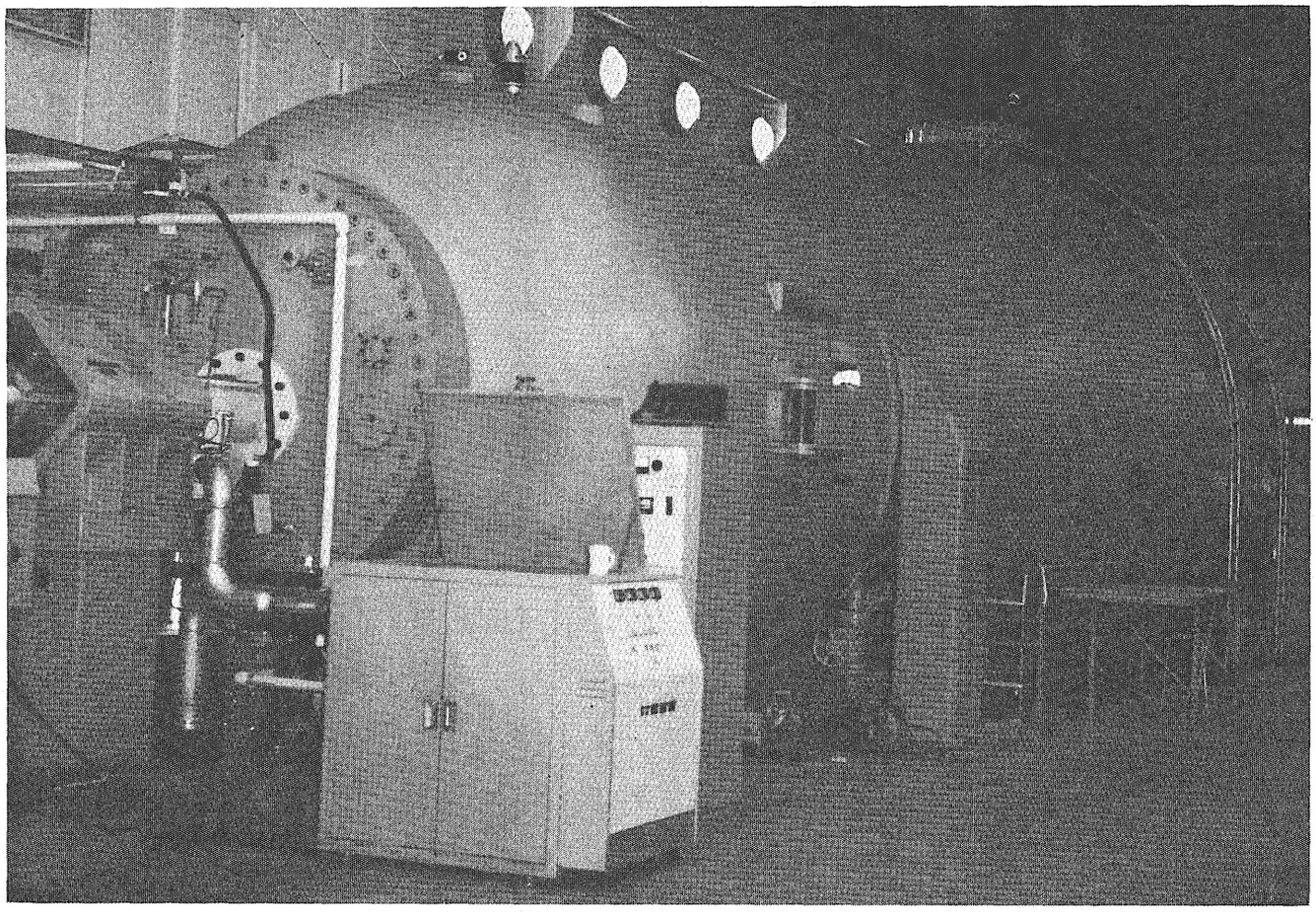
As part of the Center for Studies of the Physical Environment's program of education and communication, a newsletter, *Environ*, will be distributed on a monthly basis to students, University of Minnesota faculty, Regents, Legislators, and upon request to anyone interested in the Center. This article is the first issue of the newsletter.

Where envirnomental affairs are concerned, a serious problem of communication exists within the university and the Institute of Technology. This newsletter will attempt to alleviate the problem by keeping you aware of Center and university-wide activity, both past and future. As part of its program, the Center will sponsor research, lectures, and discussions, and will coordinate courses. These activities will be reported and a monthly calendar of events will inform you about upcoming events.

Additionally, a number of courses, surveys, and seminars already in progress encourage interested students and faculty to attend. Hopefully, a weekly environmental calendar will appear in the *Minnesota Daily*.

A bulletin of environmental courses is presently being prepared and should be completed shortly. In addition to listing courses and programs pertaining to environmental quality and management, it is designed for the use of undergraduate students and their advisors seeking programs or courses related to environmental studies.

Any questions, comments, or requests for additions to the mailing list should be directed to: Rodger Whipple, editor; Room 243, Space Science Center, University of Minnesota.



INTRODUCING . . .

The J. H. Williams Laboratory of Nuclear Physics

by John McFeters
photos by Ron Reichenberger

The John H. Williams Laboratory of Nuclear Physics is located on the Mississippi River flats of the University of Minnesota campus. Physics graduate students and faculty use the laboratory for research on the structure of atomic nuclei. Practical experience in nuclear physics experimental techniques is gained by students for occupational application.

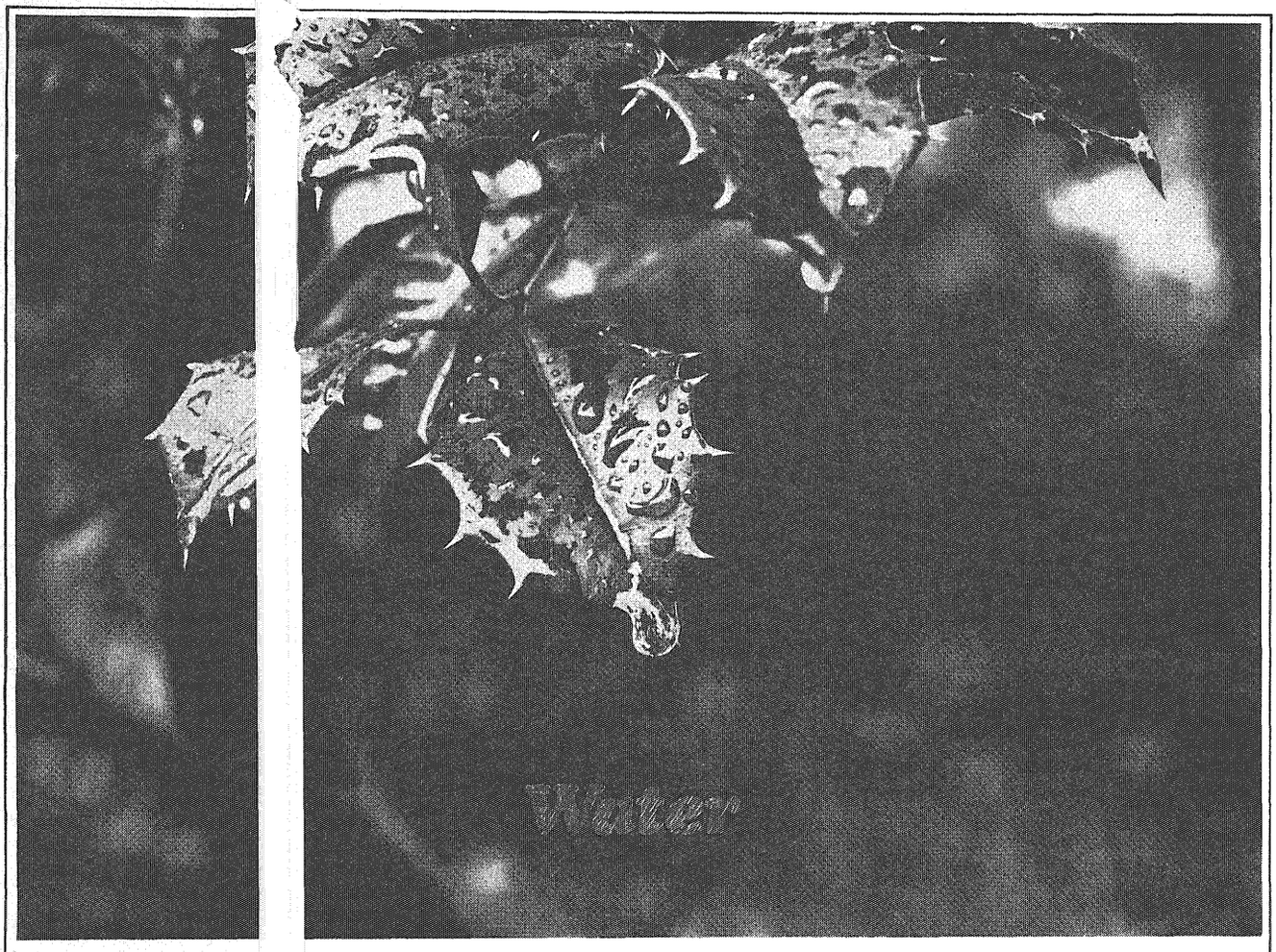
The laboratory houses a tandem Van de Graaff particle accelerator. The accelerator provides a stream of bombarding particles that are used to shoot at the nuclei of the target material. The bombarding particles are nuclei of hydrogen, helium, carbon, oxygen or nitrogen.

The accelerator energizes particles by the attraction and repulsion between charged particles and a high voltage terminal of 10 million volts. A dual or tandem acceleration is achieved by starting negatively charged particles at one end of the accelerator. Then they are attracted to the positive high voltage terminal with an energy of 10 MEV per negative charge. The electrons of the particle atoms are then removed in a stripping channel producing positively charged nuclei that are repelled by the high voltage terminal with an energy of 10 MEV per positive charge.

For example, a hydrogen nuclei can come from the accelerator with an energy of 20 MEV. The hydrogen atom becomes a negative particle by adding an electron before entering the accelerator. It is attracted to the high voltage terminal with an energy of 10 MEV, then it is stripped of both the added and natural electrons giving the nuclei a positive-one charge, and is repelled with an additional energy of 10 MEV, this totals 20 MEV per hydrogen nuclei.

If helium is used, it would be attracted with an energy of 10 MEV as a negatively charged particle, it is then stripped of electrons leaving a helium nuclei with a positive-two charge, and then it is repelled with an energy of 20 MEV. This totals an energy of 30 MEV for the helium nuclei.

The bombarding particles are shot at the target material in order to perform different types of experiments.



Conserve it. Respect it.

Make a career out of it.

More people are de
water resources tha
day we are facing a
quality of life by ba
water resources with
environment. It is a
That's where you co
needs engineers who
ture, who have a cre
lems, and who wa
planners, landscape-
to build a better qua
real involvement an
committed to meet
chance to make it co
Our challenges are r

ng more benefits from our
er before in history. But to-
w challenge: enhancing the
ing the development of our
preservation of our natural
order, and it has to be filled.
in. The Corps of Engineers
interested in the broad pic-
e approach to today's prob-
to work with economists,
itects, biologists, and others
of life. This is a chance for
hievement with an agency
changing public needs—a
.

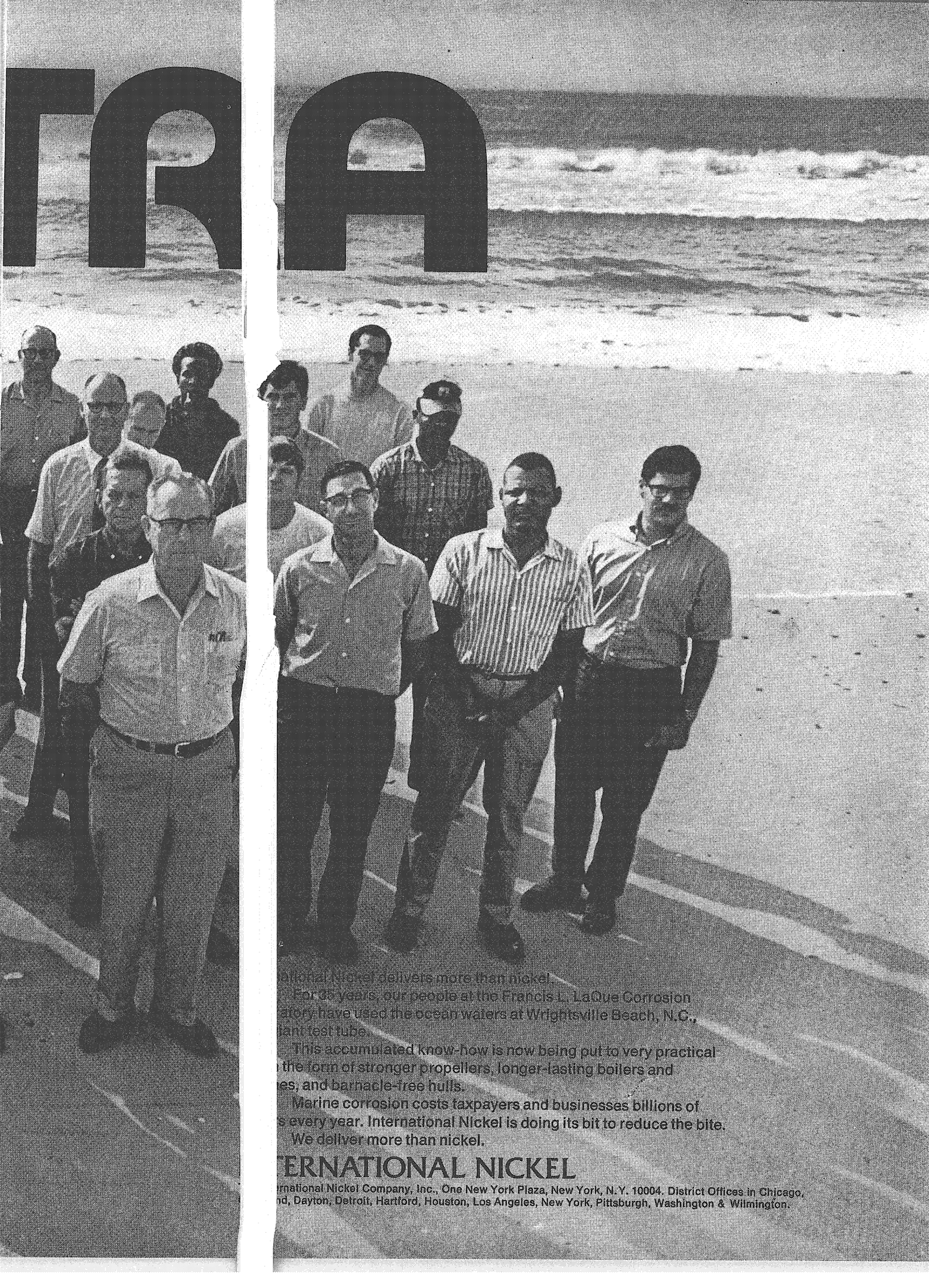
oncerned solely with water resources. We are also applying all the techniques of modern technology to the improvement of our construction capability — systems analysis, computer technology, advanced materials research, and many more. As a Corps professional, you will face these challenges as a member of the largest engineering/construction organization in the world. Think about a career with us . . . and write today for full information.

Corps of Engineers

Department of the Army
Washington, D.C. 20314

An equal opportunity employer m/f

EXT



tRA

ational Nickel delivers more than nickel.

For 35 years, our people at the Francis L. LaQue Corrosion
atory have used the ocean waters at Wrightsville Beach, N.C.,
lant test tube.

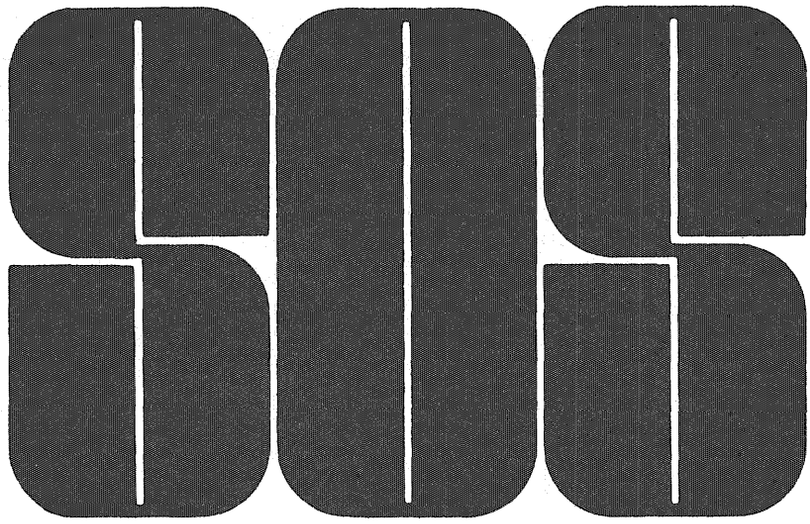
This accumulated know-how is now being put to very practical
the form of stronger propellers, longer-lasting boilers and
es, and barnacle-free hulls.

Marine corrosion costs taxpayers and businesses billions of
every year. International Nickel is doing its bit to reduce the bite.

We deliver more than nickel.

TERNATIONAL NICKEL

rnational Nickel Company, Inc., One New York Plaza, New York, N.Y. 10004. District Offices in Chicago,
nd, Dayton, Detroit, Hartford, Houston, Los Angeles, New York, Pittsburgh, Washington & Wilmington.



In an institution as large as the University, students inevitably run across difficulties—

SOS can help.

by Gary Swanson

In an institution as large as the University, students inevitably run across difficulties. Some of these problems are directly related to University regulations and policies, others stem from misunderstandings between students and teachers or administrators. Sometimes students are treated unfairly, or their special circumstances are not considered.

Very often students in this type of situation don't know what they can do to resolve their problems. In 1968 a group of CLA students organized the Student Ombudsman Service (SOS) to give advice to such students and to actively aid them in finding acceptable solutions to their problems.

SOS has never turned away non-CLA students, but since it was a CLA organization (financed and controlled by CLA Board) most of the information collected and distributed by the SOS staff was concerned with CLA students and CLA problems.

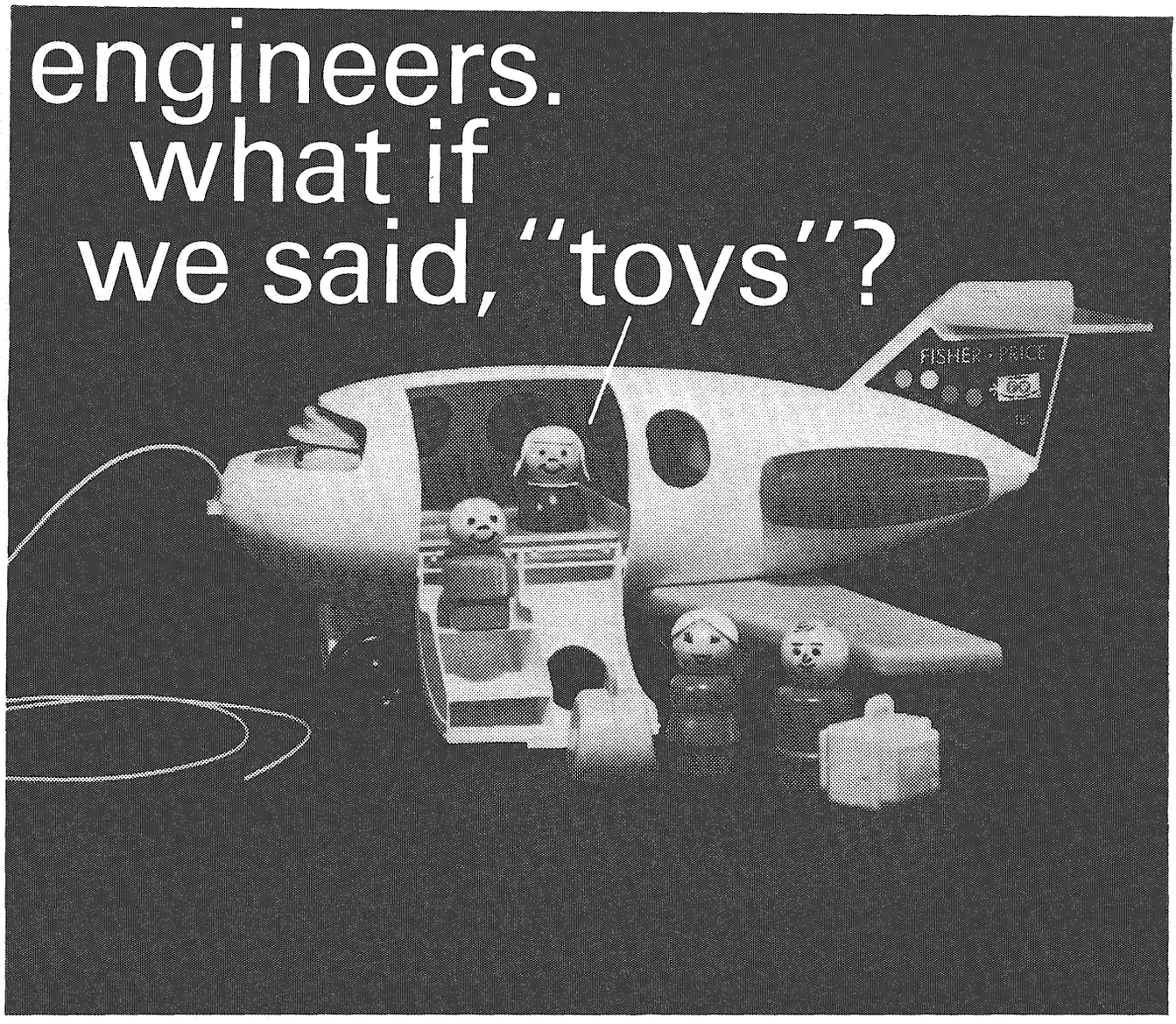
Last fall SOS began receiving funds from the student incidental fee ($.04 per student) on a University-wide basis, and therefore expanded its services to include all the colleges of the University. As a part of the expansion, SOS has added to its staff an IT student ombudsman, and has begun working closely with the IT administration. All the ombudsmen (and women) have received training in IT procedures and regulations, and are prepared to help IT students with any University related problem that they might have.

If you have a question about a regulation or requirement, SOS can find the answer. If you think you have been treated unfairly, as in grading, SOS can help you to present your case to the right people. If you have a complaint, SOS will see that it reaches the place where it will do the most good. SOS may be able to help you get into a closed class, or arrange an exception to a regulation, or a change in policy.

Perhaps you would just like to talk things over with someone, or find out what the possibilities for change are. If so, stop in, or phone the SOS office and talk with someone on the SOS staff. The SOS office is located in 102 Johnston Hall, phone number 373-9788. The office is open Monday through Friday from 8:00 A.M. to 4:00 P.M., even through the lunch hour. If you need help, stop in at 102 Johnston Hall and talk to SOS; they could have just the answer you need.

For any comments, questions, or information call Gary Swanson, 722-9691, or at SOS 373-9788.

engineers. what if we said, "toys"?



You might have a little trouble making the connection . . . but, at Quaker an engineer gets involved with many types of projects . . . projects directly related to your particular discipline. We seek Chemical, Mechanical, Civil, and Electrical Engineers for a wide variety of work in Research, Food and Chemical Production, and a host of other jobs.

Still primarily a food company, our rapidly changing product line indicates growth and diversification. Aunt Jemima, Cap'n Crunch, Puss & Boots and Ken'L Ration are a few of the established brand names associated with our company. Quaker expansion is directed into a number of new businesses . . . speciality chemicals, restaurants, frozen foods and now, Fisher-Price Toys. Our diversity, flexibility and international operations can mean a high degree of mobility for the skilled, innovative individuals we seek.

Quaker's continuing commitment to success demands an ability to grow and change . . . in this atmosphere there is no room for the engineer who avoids responsibility. If the future of our company is something you might like to be a part of, talk to our representative when he visits your campus or write to: Supervisor—College Relations, THE QUAKER OATS COMPANY, Merchandise Mart Plaza, Chicago, Illinois 60654. An Equal Opportunity Employer. *Our Representative will be on campus MARCH 5, 1971.*

QUAKER

THE QUAKER OATS COMPANY

LOG'S LOG

by Ace & Zeus

INTRODUCTION:

Now that February is here and roses are up to $1.50 each, the expeditionary force thought we'd throw in a word of thanks to all who made those delicate beauties worth a penny a minute. We must extend a special thanks, however, to all our crawling friends (i.e., ants, caterpillars, editors, and roaches) who do such a fine job of making our life a little more miserable. I guess that Polish coyote did have the right idea. After chewing off three legs, he stole the trap!

Lush's Cornernerner

This month we thought we'd ask Bruce to mix up something that would really turn everybody on. In honor of his favorite holiday, the anniversary of Edison's light bulb, he uncorked his imagination and came up with his original B's B&B coffee a la Log. This was rather unusual since he has had trouble lately with his corks, or is that corked? (As he says, "It's easy to get them in, but they're sure a dickens to pull out.")

This month's recipe goes as follows: Pour in one jigger of scotch into a coffee cup and one or two tablespoons of sugar. Fill with strong black coffee. Happy 3 a.m.

The Expeditionary Force Rides Again

Two of Ace's old buddies from the Old Country, Rings and Superfast, have submitted this month's winning questionable question. For this they receive an all-expense-paid one way trip to India. Now here's that questionable query: "What is the actual purpose of the Expeditionary Force?"

Zeus and I ace-umed that everyone in the world knew that the E-F Team is in charge of collecting and reporting little-known and better forgotten facts. Well here are some of the shocking facts, that have crept out of the murk and revealed themselves. (Oh really?)

General Trivia

49% of the married people on campus are female. (Our librarian screwed it up!)

5% of all IT co-eds are girls.

80% of women's libbers are actually foresters in disguise.

110% of all alcoholics are either drunks or engineers.

Now here are the most popular party games on campus.

Post Office

Pony Express (Like the aforementioned, only with more horsing around)

Spin the Bottle (That's a good example of getting the most out of something)

Strip Poker (First strip, then . . . . . .)

Incest (A game the whole family can play)

Next are the results of a poll we took. We asked, "What is the first thing that comes to your mind at the mention of the following: The Daily?"

Suitable for puppy training.....11%

Something you do in the morning.....23%

Beautiful for wrapping fishheads in.....32%

Works better than a corncob.....34%

A newspaper 0%

Our last biggy fact for the month is the results of our research as to why men get out of bed. Here are our findings:

To eat 3%

To go to the bathroom 4%

To go home 93%

The Log Staph

A good definition of a basketball team is a bunch of guys who dribble in their shorts. Around this basic truth, the famous Technolog team, The Log Staph, was organized. Since its existence in I-M basketball, this fantastic group has consistently played to utter perfection.

In our first game, we completely out-classed The Chinese Student Association. Amid shouts of "Shoot that man," "Remember Pearl Harbor," and "Mousey Tongue" the Log Staph took the first step on the road to the championship.

We continued our consistent play in our second game when we definitely demoralized the "B.C. Bombers." They were speechlessly astonished with our tremendous skills. When the buzzer sounded, the margin of victory was 34 points.

Our third game was an instant replay of the first two. Fungoes A.C. were the victims of our devasting teamwork. The Log Staph just kept right on rolling. Fungoes A.C. still cannot believe how such a team could be fielded.

Now, with a perfect season behind us, The Log Staph heads into the playoffs. No doubt, our fortunes will continue in the tournament. With yours truly, Ace, at the helm, how can we fail?

Official Daily Bull

It seems that there has been a lot of extra commotion around our office door in the past few weeks. The cause of it all is a not so tiny piece of canvas attached to one

of our more insignificant plastered bounderies. Somewhere between a take and a double take of "Canvas a la Strandberg" we lost two doors, three EE's, seven slipsticks, and a stray dog that just happened to be passing in the near vicinity.

This leads us to the Log's Log Mind Masher of the Month:

"Come as you are, but you may not leave that way."

Feb. 15-28

15—Goose Day

19—Second annual long distance call girl day, it's cheaper after five if you don't mind being sixth.

22—Cherry tree Day: Scratch a cherry from the virgin woods; father refuses to bury the hatchet.

31—Polish Day of intelligence.

March 1-14

1—Birdie Day. Bird of paradise let loose, everybody hold your nose.

5—ELF Day = raindeer games ½ price. (What's a raindeer game?) HO HO HO! LITTLE ELF!!

12—Goodyear Day; when the rub-'er meets the road.

13—Fender day—go out and get bent.

Ace's Appeal for the Month

This month we include a desperate appeal for help for our token freshman. He's in a definite hurt for a little warmth.

The guys over in mortuary science tried to help but the only available bodies were stone cold. After his handwarmer, his dog, and his thermal underwear had all failed him, he turned to the super Log Team for aceistance.

In order to determine how badly off the boy was, we gave him a psyche test—a word association game. We quit after the first word, however, when he responded to "asphalt" with "rectum disease." Ace later found him to be perfectly sane when he put the round pegs in the square holes, applied at Morrill Hall for his Engineer's Library Pass, and had successfully greased his slide rule after procuring the fittings.

Zeus and I finally came to the conclusion that he needed some lovin' (i.e., a girl). Our hypothesis was confirmed when he attacked the painting of a nude which hangs over the sexional in the Log Office.

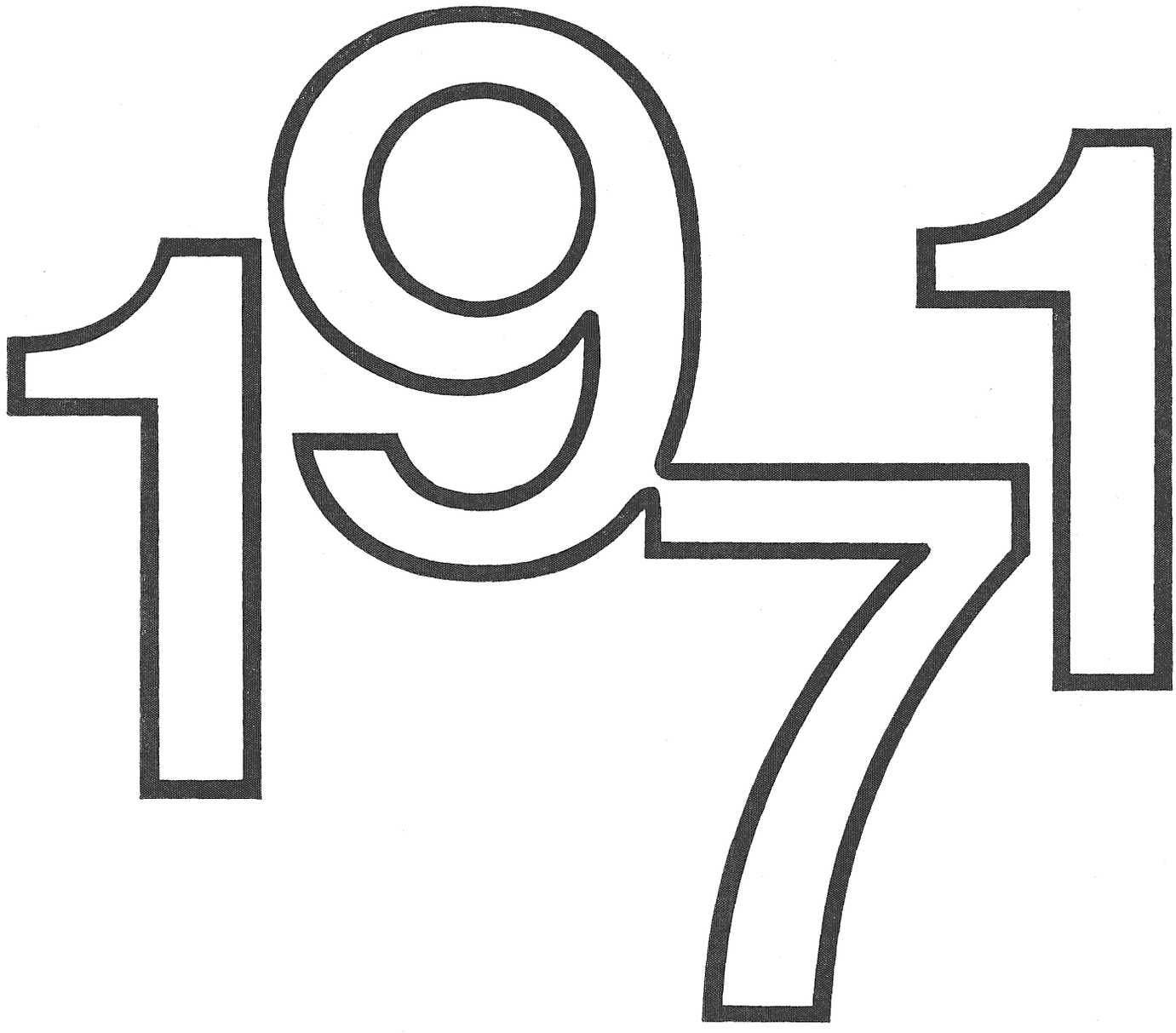
Girls, unless you want the death of this poor specimen on your conscience, please stop in and offer your services. Also, be sure and "raspberry."

CONCLUSION: The E.F. Team is now in full form. We . . . . . .

BULLETIN: Ace and Zeus have just received shocking news. Contrary to popular belief, Foresters do NOT bleed when hit on the head with a beer bottle!

. . . . . but since the sun only rises in the north when the lemmings return from Slobbovia after killing off three sregrubhsif, the fantastic Log Team bids ado. (We do?)

If you are a senior...



could be the most important year of your life.

As you contemplate one of the most important decisions of your life, you will want to remember this: it is not just "a job" you are seeking—it should be the beginning of a career. And if it is to be successful, both you and your employer must need and want each other.

To help you with your decision, we invite you to consider the opportunities at Pratt & Whitney Aircraft. Currently, our engineers and scientists are exploring the ever-broadening avenues of energy conversion for every environment . . . all opening up new avenues of exploration in every field of aerospace, marine and industrial power application. The technical staff working on these programs, backed by Management's determination to provide the best and most advanced facilities and scientific apparatus, has already given the Company a firm foothold in the current land, sea, air and space programs so vital to our country's future.

We select our engineers and scientists carefully. Motivate them well. Give them the equipment and facilities only a leader can provide. Offer them company-paid, graduate-education opportunities. Encourage them to push into fields that have not been explored before. Keep them reaching for a little bit more responsibility than they can manage. Reward them well when they *do* manage it.

Your degree can be a B.S., M.S., or Ph.D. in: MECHANICAL ENGINEERING • AERONAUTICAL ENGINEERING • ENGINEERING SCIENCE • ENGINEERING MECHANICS.

If your degree is in another field, consult your college placement officer—or write Mr. Len Black. Engineering Department, Pratt & Whitney Aircraft, East Hartford, Connecticut 06108.

Pratt & Whitney Aircraft

EAST HARTFORD AND MIDDLETOWN, CONNECTICUT

DIVISION OF UNITED AIRCRAFT CORPORATION

An Equal Opportunity Employer

Electronically Controlled Fuel Injection

by Don Neal

Fuel Injection (FI) has long been recognized as the way to achieve maximum output from an engine used in racing. It can also be used to squeeze an extra increment of power from a street engine without sacrificing smooth low-speed operation. The superiority of FI to carburetion is achieved through complication and cost. Carburetion has improved steadily through the years and continues to justify its use by doing its job efficiently. However, the maximum advantages of FI are restricted by the mechanical limitations of the metering device. By adopting electronic controls instead of mechanical, it is possible to have a FI system in which the supply of fuel can be regulated precisely to suit changes in requirements automatically.

The federal and California emission control laws now add a new parameter to design consideration. Other than FI, designers are faced with three compromises: (1) added complication and cost in the form of add-on devices; (2) loss of performance resulting from modifications to the ignition timing and valve timing; (3) loss of general "driveability" because of very lean carburetion for part throttle operation. Now FI and especially electronic controls take on a new charm: alternative (1) will pay a good part of its cost and alternatives (2) and (3) need not cause any problems at all.

Other than racing applications, several systems have been used in production automobiles. Chevrolet offered the complex Rochester mechanical system on the Corvette. The Rochester system was used on the 375 h.p. engine and cost $411 as an option. Rambler and Chrysler had the original Bendix electronic injection system for a similar cost in 1957-58. Mercedes Benz uses the Bosch timed injection system on its more expensive models. This mechanical system is expensive ($600 as an option on the 250S) and looks like a plumber's nightmare under the hood, but it is highly refined and reliable.

Electronic injection systems are available from four makers today. Volkswagen of Germany offers the VW-Bosch (VW) electronic FI system on its Model 1600. Associated Engineering Ltd. of Great Britain (AE), Conelec, and Bendix also make complete systems. These four systems will be examined in this article. Specifically, the electronic control in each system will be considered.

At this point, it will be well to set down some definitions pertaining to FI. *Direct cylinder injection* squirts the fuel right into the combustion chamber; *port* injection puts the fuel charge into the intake near the intake valve; *timed* injection controls precisely the length of time the fuel is squirted (according to such variables as engine speed, manifold vacuum, coolant temperature, etc.), whereas, *continuous* injection makes no attempt at timed squirts but merely regulates the quantity of steady flow. Some systems fall between these two categories. *Metering* is any means of regulating the fuel quantity delivered and falls into two types: mechanical and electronic.

General Operation

The four FI systems are similar in operation, receiving five elementary signals from the engine and electronically controlling the amount of current to the injectors. The main difference is in timing. The AE and Conelec systems feature continuous injections. All injectors receive fuel simultaneously, once every cycle of the engine. The VW system divides the cylinders by firing order (1, 4, 3, 2) Cylinder pairs 1 and 4, and 3 and 2 receive fuel once per engine cycle. Bendix gives fuel to each cylinder before each respective intake valve opens. It is the only fully timed electronic injection system. There is a general trend, which is making FI feasible for mass-produced cars, and that is to get away from the "ideal" or perfectly timed fuel impulses delivered to exactly the right place (the combustion chamber.)

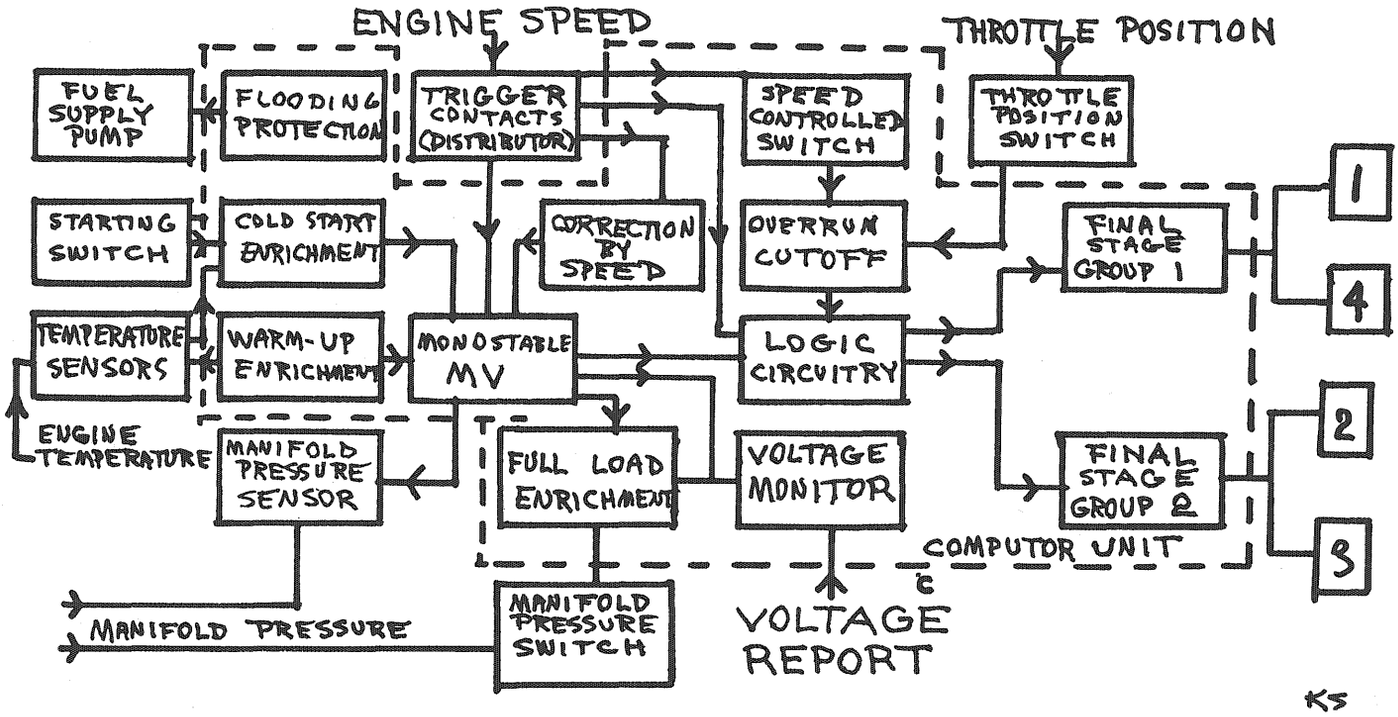


Fig. 1. The figure above shows the basic system used by all fuel injectors.

All four systems feature port injection.

The rate at which fuel is delivered is controlled by a computer, which is programmed according to information obtained during engine development tests. Five sensors supply the computer with signals indicating engine conditions. These sensors are: Engine speed, engine temperature, throttle position, manifold pressure and voltage input. A ring main, which supplies the injectors with fuel, is maintained at a constant pressure. (VW: 28 lbf/in^2; AE: 25 lbf/in^2; Conelec: 20 lbf/in^2; Bendix: 20 lbf/in^2.) Gasoline is fed continuously to each injector, but fuel is sprayed into the inlet port only when a valve in the injector is opened by a solenoid. Electrical pulses come from a trigger device on the distributor. This is where injection timing is controlled. The rate of injection depends on the signal from the computer to the distributor. In Figure 1, a simplified layout diagram gives insight to the general operation of each system.

Sensor Operation

The computer gets signals from four basic sensors: a temperature sensor, intake, manifold pressure sensor, speed signal from distributor, and throttle position. The temperature sensor is a thermistor which is a temperature sensitive resistor. Thermistors of both positive and negative temperature coefficients are used in the VW and AE systems. A thermistor is inserted in the cylinder head (AE, VW) and transmits a signal to the electronic computer to enrich the mixture when the engine is cold and progressively to reduce the enrichment when the engine warms up. Additional enrichment is provided by a thermostatically controlled microswitch opening an air-bleed valve which bypasses the closed throttle valve during idle and when engine is cold. Thermistors are used in the coolant (except VW), in the intake manifold air, and in the slash oil network. The Conelec and Bendix FI system use similar devices for measuring temperature. Two thermistors, one in the engine coolant and one in the intake manifold, monitor engine conditions through change in resistance to modulator (Conelec and Bendix systems are controlled by current modulation). Cold start and fast idle are compensated for by a rheostat and thermostat application.

A transducer is a device which changes mechanical vibrations into electrical impulses. In the electronic FI systems (VW and AE) transducers are used to measure intake manifold pressure. At the conditions of before starting and full throttle the intake manifold pressure approaches atmospheric pressure. Therefore a high rate of fuel is required at start just as it would at full throttle. An inductive pressure sensor reads intake vacuum and when it drops to below 2 in. Hg the vacuum-operated switch closes which tells the computer to increase pulse duration by 1.2 ms (normally 2-8 ms) thus providing enrichment at start and full throttle even when atmospheric pressure is low. Acceleration conditions are compensated for by this sensor. Manifold pressure in the Conelec and Bendix systems is not measured directly (as in VW and AE), instead it is computed by combining an intake vacuum signal and separate atmospheric pressure signal (a sensor for each).

For deceleration a microswitch on the throttle spindle tells the computer the throttle is closed and if engine speed is greater than 1800 r.p.m. fuel is shut off completely. When engine speed drops to 1250 r.p.m. the fuel supply comes on again, thus infamous high vacuum deceleration emissions are avoided. To achieve the same effect for deceleration, the AE system uses an intake pressure transducer in the following manner: A flexible metal diaphragm divides a cylindrical container into two parts; one is connected to the intake manifold and the other is evacuated to measure absolute manifold pressure. Housed in the evacuated space is a potentiometer and wiper mechanism.

continued on page 20

Fuel Injection cont. from pg. 19

The wiper arm pivots at the side of the chamber opposite the potentiometer and a link connects it to the center of the diaphragm. Thus as the manifold pressure varies so does the voltage output of the potentiometer. When the manifold pressure falls below a predetermined level the fuel supply to the engine is cut off until the engine speed decreases sufficiently.

Signals indicating the engine's speed are sent to the main control (computer) from the distributor. The VW features a pulse generator in the distributor which signals speed. A signal related to the speed of the engine (in AE) is produced by electronically counting the pulses of the trigger distributor and is fed to the discriminator. The trigger distributor is driven at half the crankshaft speed by a gear on the shaft of the ignition distributor. Bendix and Conelec have a set of ignition-style breaker points in the speed sensor, which is installed in place of the original mechanical fuel pump and thus it gets its drive from the camshaft. A series of spikes are sent back to the modulator indicating the speed. Another signal related to the engine speed is the throttle position. A switch in the throttle closes when the throttle is closed which cuts off fuel at high speed. The action of these devices, which operate at conditions other than solid state, is the automatic compensation for the transient conditions which every car experiences. The control unit constantly monitors this information and modifies the pulse rate according to the signals from the sensors.

Main Coordinating Control

Electronic fuel injection control is independent of any mechanical devices. Sensors change mechanical and thermal impulses into electrical signals. From then on the control features no moving parts. The four systems vary in form of the main control unit. All the systems basically use resistances as signal inputs. The Conelec and Bendix utilize an electronic modulator which transform spike signals they receive from the trigger selector unit into an electrical pulse of a given standard width. Simultaneously, sensing elements send out signals indicating engine operating conditions. The modulator control integrates these signals into the standard pulse width circuit and then transmits the modified electrical pulse to the selector portion of the distributor and thence to the fuel injector. So, as the sensing circuits' resistances increase the solenoid valves are held off their seatings in the injector longer, thus increasing the quantity of fuel.

Injectors are opened by an electromagnet in the injector valve. Each injector is opened once every engine cycle, but the length of time the injector is open (and amount of fuel injected) is controlled by the computer. VW and AE each have similar computer control devices. Essentially the sensors send an electrical signal to the computer. Inside, the signals are fed into a mono-stable, multivibrator (MS-MV). This changes the electrical signal into a pulse. The MS-MV changes from its stable *off condition* to its unstable *on condition* when a triggering pulse from the distributor is received. In other words, the MS-MV is fired by the trigger distributor. The *on* period (time when injector is open) of the MS-MV depends primarily on the inductance of the manifold pressor sensor, but is modulated according to the non-linear requirements of the engine fuel characteristics by a corrective speed circuit. Additional circuitry processes and modulates the multivibrator time period to compensate for transient conditions. In addition, the computer houses a voltage calibrating circuit that reduces the injection period slightly to compensate for supply voltage changes. This is necessary because the injector valve rise time decreases and valve closing delay increases with voltage. Without compensation these characteristics would cause an increase in fuel volume with a higher supply voltage.

The VW computer contains one power amplifier for each group of injection valves, the time delay network, and miscellaneous circuitry for deceleration control and flooding protection. The power amplifiers are driven by a series of gated pulses generated from a combination of pulses, from the trigger contacts, and the time delay circuit. A logic circuit insures proper correlation between power amplifier and trigger contacts to exclude unwanted fuel injections that could be caused by contact bounce. The computer contains over 200 components, including 25 transistors and 35 diodes. The VW computer and the AE discriminator are programmed from information obtained during engine testing and development.

Design Criteria

The VW fuel injection was designed for the purpose of controlling exhaust emissions. Add-on devices like the PCV valve would tax the power output of the small (1600 c.c.) VW engine, therefore injection also offers increased efficiency. The California emission control laws specify a maximum of 2.3 per cent carbon monoxide and 410 parts per million of unburned hydrocarbons in the exhaust. VW-Bosch engineers compiled performance curves showing torque vs. pulse length, fuel consumption vs. pulse length, HC vs. pulse length and CO vs. pulse length. See Figures 2-3 for a graph of the curves. When a VW test car was tested according to the California test cycle, the carbon-monoxide level was 0.3 to 1.0 per cent and unburned hydrocarbon was about 180 to 270 parts per million. These measurements are well within the California requirements.

In the Figures the abcissa is the length of pulse, which is proportional to the quantity of fuel delivered per pulse; the ordinates for the families of curves are torque, fuel consumption, HC concentration, and CO concentration. The four families of curves are all from the same test, in which engine speed, intake manifold pressure, and ignition setting were held constant for each curve and only the length of the pulse was varied (each individual curve, however, is for a different manifold pressure). Looking at the top family of curves, we see that as the pulse length is increased, torque increases. However, if the fuel delivery is increased further the torque would eventually fall off because of misfiring of a too-rich mixture. The second family of curves shows that fuel consumption decreases (to a point) as the pulse rate increases. The two families of curves below show what happens to the pollutant concentrations at the same time.

The Bosch engineers chose CO concentration as their governing param-

eter; they picked the point on the hook-shaped CO curve where concentration took a sharp upswing, and made that the pulse-length calibration for that engine speed, manifold pressure and ignition timing. This is shown as a circle on all four sets of curves. Figure 6 shows pulse duration vs. absolute manifold pressure for the VW and AE systems and Figure 7 shows brake horsepower and specific fuel consumption vs. engine speed (AE) and pulse length (VW). Both systems were tested on four cylinder engines, however the AE setup had a larger displacement engine.

Fuel Injection cont. on page 30

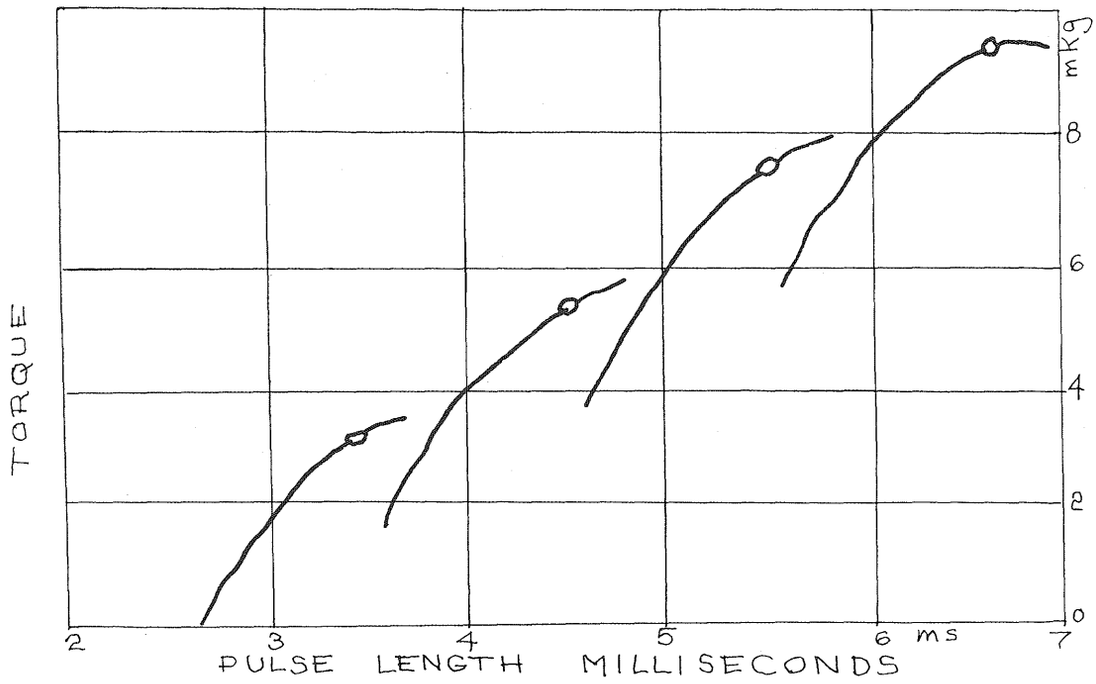
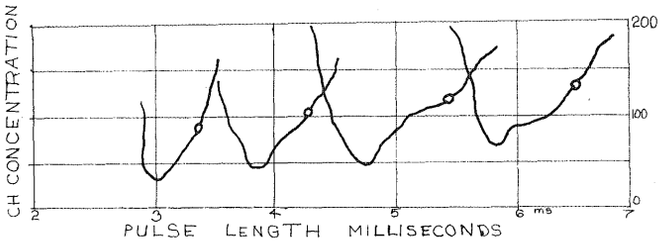


Figure 2, left; figure 4, below.

The family of curves on this page shows the relation between torque and pulse length, fuel consumption and pulse length, hydrocarbon concentration and carbon dioxide and pulse length. This information was compiled by VW-Bosch Engineers.

The circles on the graph represent optimum performance as selected by the engineers.



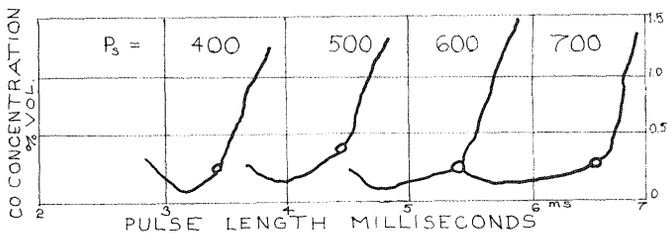
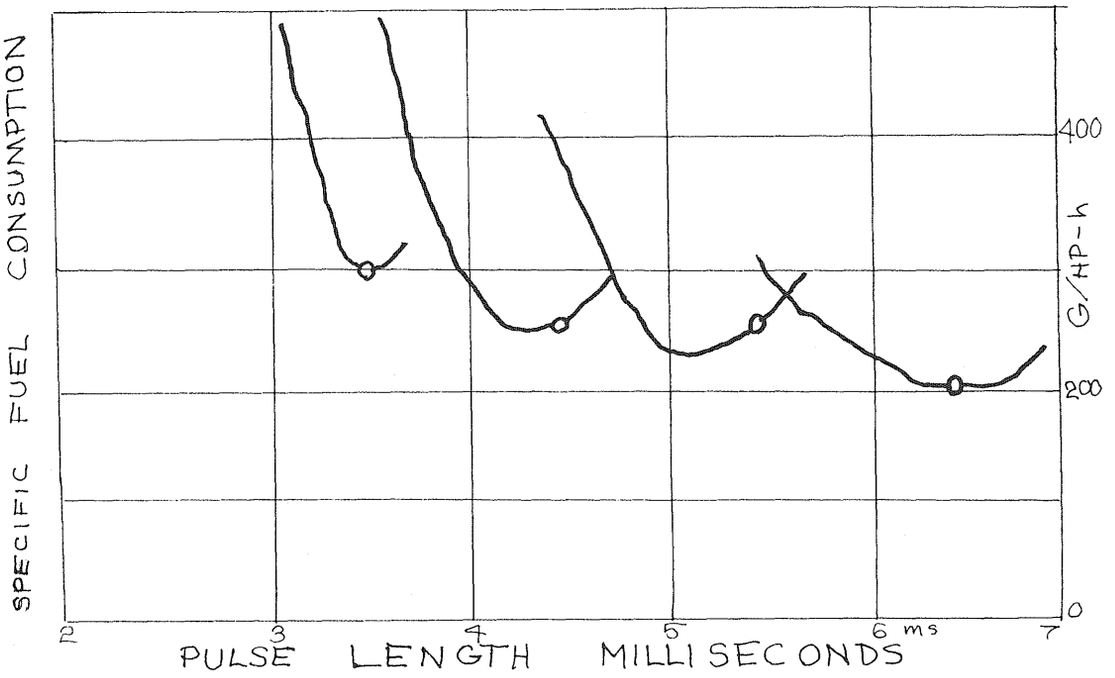
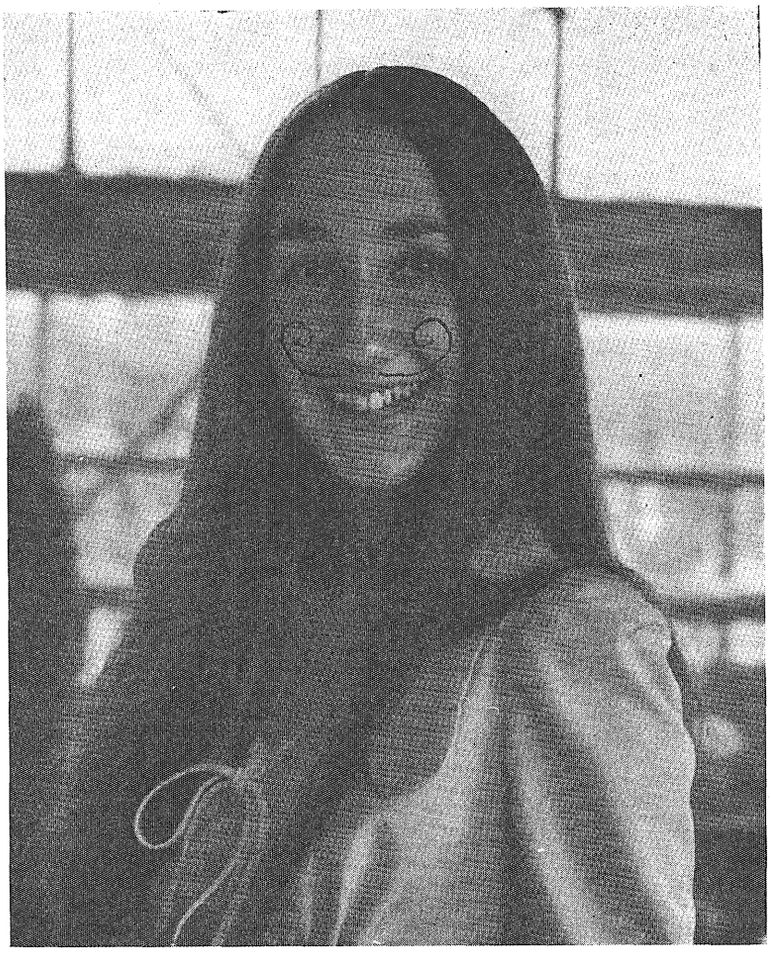


Figure 3, above; figure 5, right.



MISS FEBRUARY

BETTY KINNE

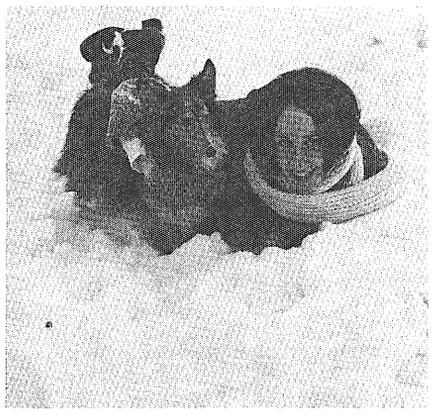


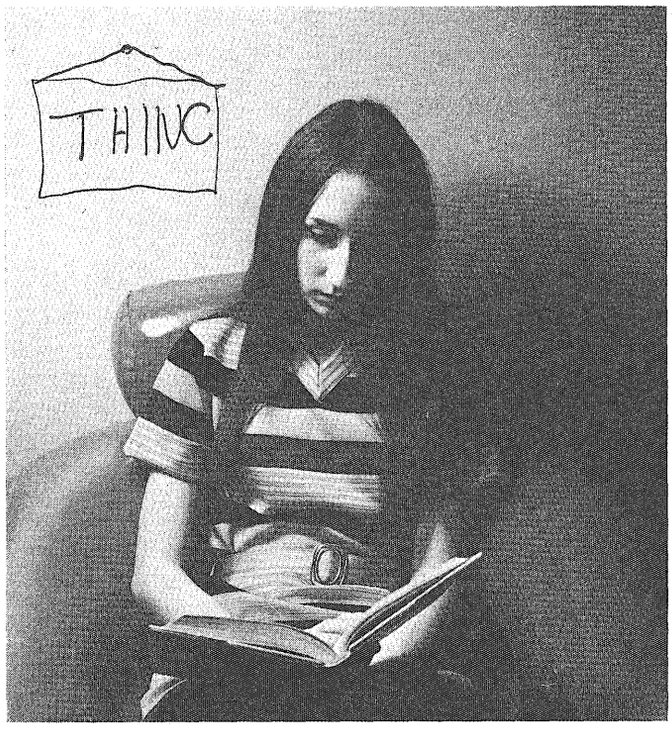
Photos by Brian Johnson

The beauteous bod which has bedeviled us this month is Betty Kinne, a sophomore from Eden Prairie. We discovered Betty strolling through the Como Park Conservatory last week and definitely decided that she should be our Miss February.

5' 5" Betty is majoring in Home Economics Education. When she has time, Betty likes to frolick in the snow with Sir Russel Kinne of Eden, as one can easily see.

Betty Kinne has surely stolen our hearts which makes her an even more timely Miss February.



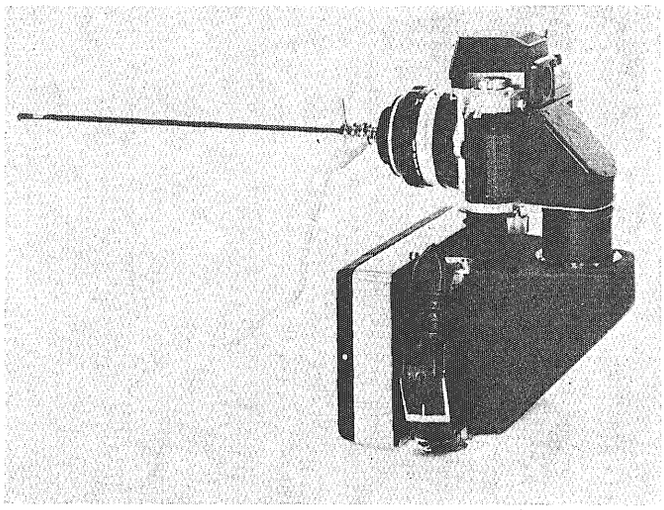

THINC

What's New

...in Science and Engineering

Interior Photography

Camera Adapter Eyepieces for National Borescopes and Endoscopes permit motion pictures and still photography. Borescopes and Endoscopes equipped with the Adapter can be used directly with most single-lens reflex-type cameras having #5 camera thread or using "Tiffin" rings.



With the Camera Adapter, it is possible to photograph interior surfaces and cavities during normal borescope-endoscope procedures. Illumination for photography is provided in National Borescopes and Endoscopes by lamps at the tips of the instruments. The exposure is indicated on the light meter in the camera, and the photograph is taken through the viewfinder of the camera.

The adapters may be attached to cameras equipped with a magnifying lens and to Polaroid cameras to obtain greatly magnified photographs instantly, without the necessity for additional enlargements or labor. The adapter, attached to endoscopic instruments, can be easily installed and removed from most brands of cameras.

Computer Construction Game

A computer program designed to teach construction management to managerial trainees has been presented. The program is set up so that the trainee can get the feel of being in charge of a construction project.

To begin the game the player inputs the network description of a project of his choice, together with the crew breakdown by activities in terms of carpenters, electricians, etc. The computer then generates an estimate of the construction progress in terms of percent complete and the financial expenditures, period by period throughout the life of the project. This estimate is designed to approximate the information available to the project manager from his company-estimating section at the beginning of the project.

During each period the player receives a print-out giving the weather and worker efficiency factors for the period just completed, together with progress to date in terms of percent complete and dollars expended. The objective of the game is to complete the project within the number of periods estimated during the initial presentation and at the lowest total cost.

Should the total cost of the project exceed the expected cost by 10 percent or more (the assumed profit margin) the project is constructed at a loss and the game is lost. With minor modifications the game can be played using either remote teletype or batch mode input.

All Weather Electric Pickup

A reinforced fiber glass cab and safety-glass windshield with wiper give an all-weather capability to the new Model 135 Pickup, latest addition to the Westinghouse line of electric-battery-powered vehicles and its first all-weather pickup truck.

Industrial plant complexes, warehousing facilities, mobile home parks, outdoor sports facilities, universities, schools, and other institutions will find the vehicle a silent, fume-free and low-cost means of moving men and materials through their areas.

Mail, maintenance and security patrols are typical applications. The truck carries two passengers plus up to

500 pounds of cargo on its 42-by-33-inch deck. A dependable four-solenoid resistor-type control gives smooth speed changes up to top speed of 12 miles per hour, while the vehicle's three-wheeled design gives easy maneuverability.

Six six-volt lead-acid batteries power a 4½-horsepower traction-rated d-c motor through an enclosed automotive-type drive. After about 30 miles, the heavy duty 170-ampere-hour batteries will need a recharge. A built-in automatic battery charger plugs into any 110-volt outlet.

Frame, deck and doors are steel. The doors have snap-on vinyl plastic windows. Rear tires are 5:00 x 5:70 x 8 and the front tire is 8:50 x 8.

The vehicle is 102 inches long, 45 inches wide, and 66 inches high and weighs 1125 pounds with batteries. A cabless indoor version is also available.

Stereo Photos of Moon

Among experiments Apollo 14 astronauts performed this month on the moon, one of the most important was to take close-up photographs of the lunar surface—in stereo and color—for scientific study.

The astronauts planned to photograph the fine structure of lunar soil and to bring samples back to earth. They also photographed features of the lunar surface they couldn't bring back—parts of larger rocks, fissures, or the junction of formation in the hilly upland about 50 miles north of the crater Fra Mauro. This region is of great scientific interest and is quite different from the flat landing sites of Apollo 11 and Apollo 12.

By studyng the structure of lunar objects as well as the color, size, shape, and variety of individual particles shown in the close-up photos, scientists hope to learn more about the lunar surface in this older region than they might learn solely from the actual soil samples or other lunar photographs the astronauts bring back.

It is hoped that the close-up stereo photos will provide further clues on such questions as: what are the lunar rocks made of? how were the craters formed — by meteors, by volcanic action, or by what combination of the two? and where did the moon come from?

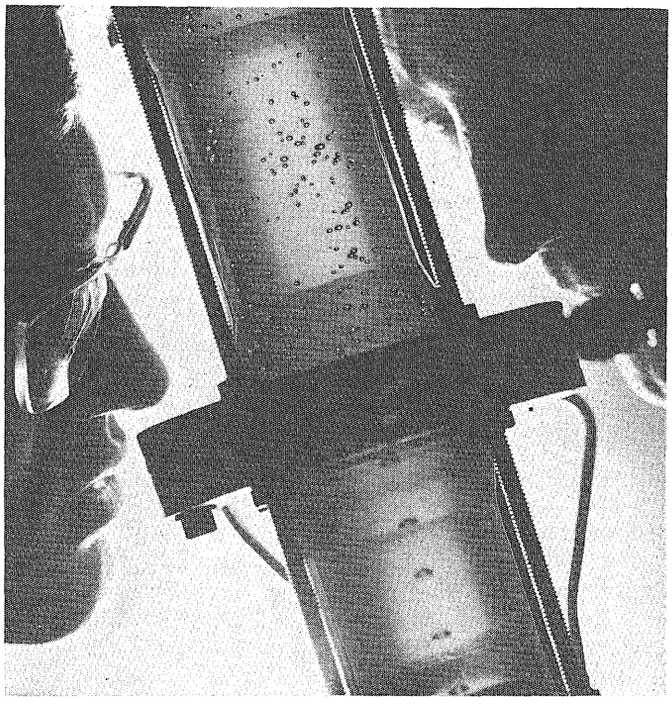
Because the astronaut photographers wear pressure suits with heavy gloves, and visibility, mobility, and dexterity are limited, a camera was designed that's as simple as possible to use. The camera has a collapsible handle that resembles a walking stick. The astronaut photographer could, without bending over, rest the camera on a lunar rock or the filled-in area at the edge of a lunar rock, then simply press trigger on the handle to take a picture.

The camera holds firm slightly less than 10 inches away from the surface. The photographs enable scientists to see particles smaller than 2/1,000ths of an inch (between 30 and 40 microns) and to identify the shape of particles at least as small as 4/1,000ths of an inch (100 microns).

The two lenses of the camera have been fixed in focus and are separated in such a way as to provide a 9-degree stereo angle.

Aerospace Technology Aids Pollution Solution

TRW Inc. engineers check out a liquid-gas separator originally designed to remove gases from liquids in spacecraft and rocket engines. An oil-water separator employing the same surface tension principle now has been developed to clean up oil spills and to reclaim oil from



industrial waste waters. The three engineers who invented the device at TRW's Redondo Beach, California facility were recently honored by the American Astronautical Society and the American Institute of Aeronautics and Astronautics for their work in applying aerospace technology to the solution of environmental problems.

Hydraulic Crane

The Bucyrus-Erie 65-C, 70-ton hydraulic crane, with folding boom attachment, can now carry 115 feet of tubular lattice boom and a 50 foot lattice jib on the machine at all times. A separate truck to carry extra sections of boom is no longer needed. The machine can be rigging at the job with 165 feet of total reach in less than an hour and has a lifting capacity of 10,600 lbs. over the jib. With the boom folded in place and the jib stored, the 65-C will travel at highway speeds in an overall machine length of 96′3½″.

By adding a special 5 foot hinged middle section, up to 115 feet of boom can be folded in half and lowered

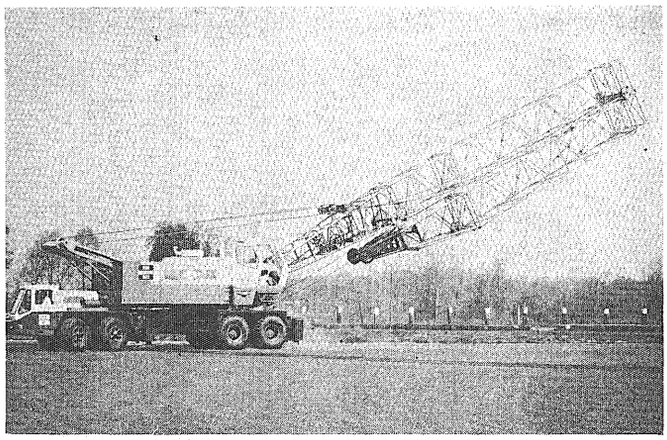
continued on page 26

What's New cont. from pg. 25

into travel position, parallel to the ground. The 50 foot jib is also removed and folded, and mounted on a special carrying rack on the side of the boom.

The folding attachments can be added to any standard 65-C lattice boom, or the complete 115 foot folding boom is also available.

The conventional boom for the 65-C has a maximum reach of 200′, or 230′ combining boom and jib. It features the unique retractable boom option which permits the 65-C to carry 60 feet of boom in an overall length of 64 feet. It also has quick locking boom connections for fast set up. A full 200 feet of boom can be rigged by two men in less than an hour, without special tools.



The 65-C has controlled free fall, optional snap-on lagging for higher line speeds, and variable hoist speeds to 364 fpm. The main hoist of the 70-ton crane has a single line pull of 24,000 lbs. Only eight parts of line are needed to lift the full 70 tons.

Collision Warning System

A new aircraft Collision Warning System (CWS) designed to give Army pilots and passengers a new measure of safety in high-density air traffic is scheduled for flight tests in three different Army aircraft.

A $97,000 contract to Honeywell's Aerospace Division calls for development of "advanced development/feasibility models" of the CWS for Army evaluation.

The basic technology developed for this system can be applied to equipment for aircraft in civilian high-density air traffic situations such as those found in the New York metropolitan area.

The new system will be compatible with a Proximity Warning System (PWS) produced under several Army programs. These programs called for production of 285 systems for use on training helicopters at the U. S. Army Aviation Center, Ft. Rucker, Ala.

The Ft. Rucker program represented the first production order in the aircraft industry for a simple, efficient system under the general heading of collision prevention equipment.

The new Collision Warning System represents a considerable advance, using more sophisticated signal processing that computes actual time to collision and extends the range from a maximum of 3,000 feet on the PWS to 10,000 feet or about two miles on the CWS.

The difference is in the amount of information given the pilot and the amount of information needed for the aircraft within a given air traffic density.

The new CWS will warn the pilot only of those intruder aircraft that represent potential collisions within a preselected time frame such as 15 seconds. An additional warning is given for aircraft in the more immediate air space.

The pilot will still get a proximity warning if aircraft are within 1,000 feet range and 300 feet above or below his aircraft, no matter what the closing rate.

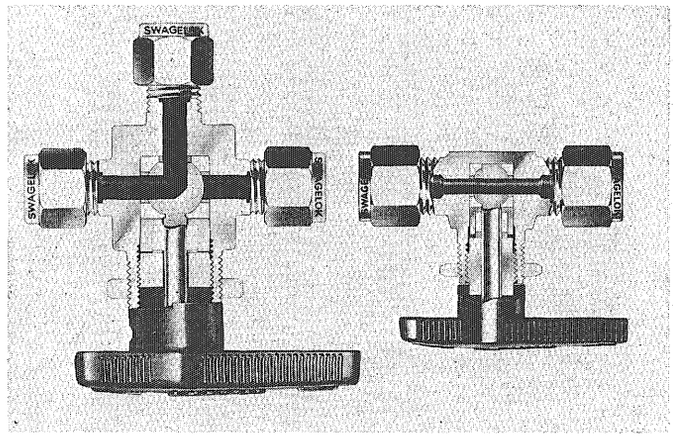
With both systems the pilot is warned of an intruder with a beeping tone in his headset and is given altitude information relative to the intruder via a flashing light display on the instrument panel. With the new CWS system the relative bearing of the intruder is also given. The systems are "cooperative," meaning that each aircraft must be equipped with a system before the pilot can send and receive the radar warnings.

Multi-mini Valves

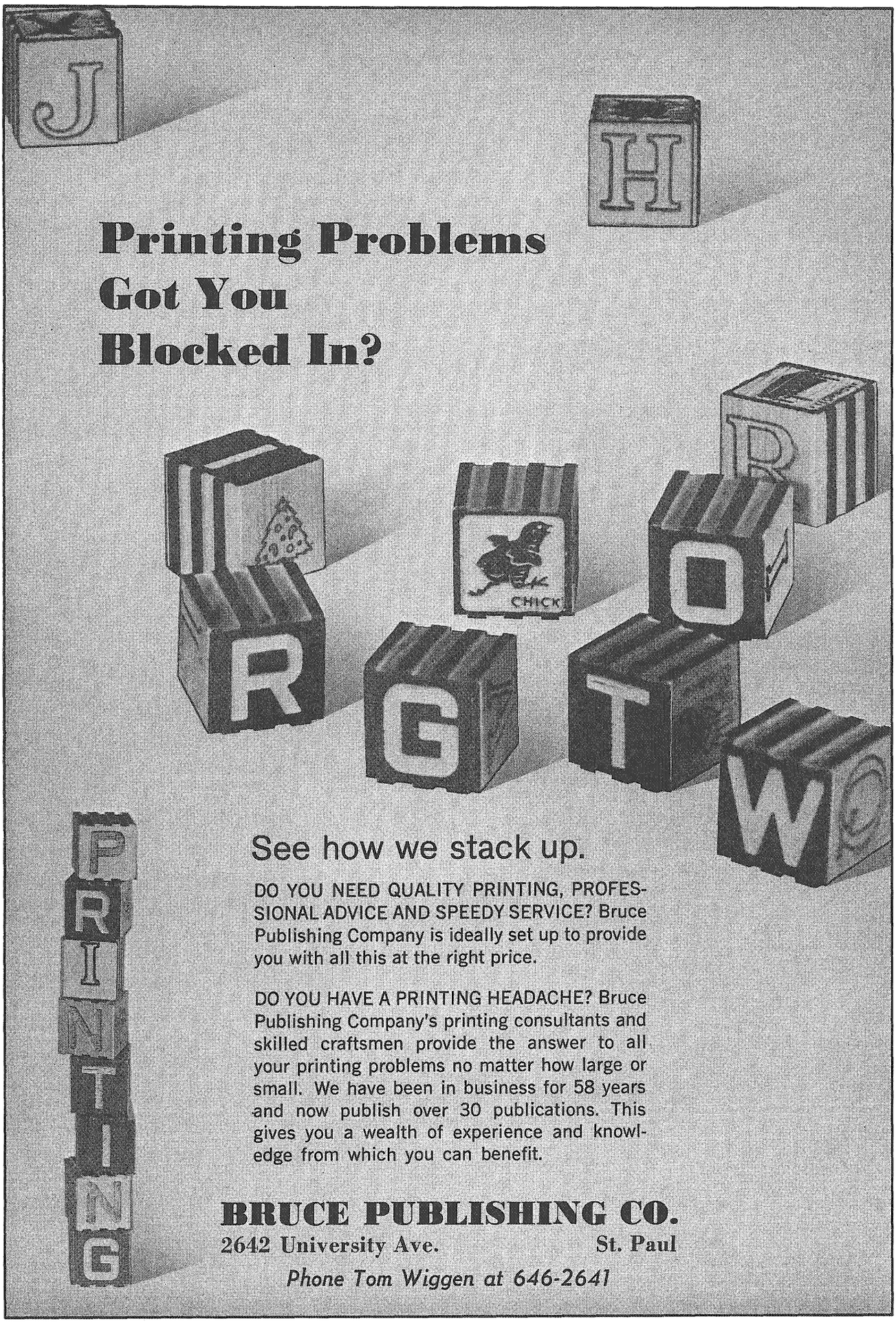
Miniature 316 stainless steel ball valves can be used for on-off and switching service in such applications as gauge shut-off, moderate vacuum systems and parallel by-pass.

Produced in two- and three-way designs, the compact new valves are of one-piece barstock construction, with top-loaded TFE packing that may be adjusted during service. Other features include elimination of internal cavities, low pressure drop, low operating torque, and positive machined stops at port positions. Downstream vent models are available for guage protection.

The two-way valve directional handle rotates 90° from shut-off to full flow. The three-way valve switches port to port in a 180° rotation with an off position at 90°. Valves are available with ⅛″ and ¼″ Swagelok connections, or female pipe ends. A universal mounting nut is standard on Swagelok and valves. The valves are available in brass as well as 316 stainless steel.



Other applications for two-way valves include hydraulic and pneumatic instrumentation and piping, gauge protection, chromatography and control panels. In addition to parallel by-pass, three-way valves can be used with switching manifolds, sampling and two sensor readout systems, and double inlet applications. Both types may be used with corrosives.



See how we stack up.

DO YOU NEED QUALITY PRINTING, PROFESSIONAL ADVICE AND SPEEDY SERVICE? Bruce Publishing Company is ideally set up to provide you with all this at the right price.

DO YOU HAVE A PRINTING HEADACHE? Bruce Publishing Company's printing consultants and skilled craftsmen provide the answer to all your printing problems no matter how large or small. We have been in business for 58 years and now publish over 30 publications. This gives you a wealth of experience and knowledge from which you can benefit.

BRUCE PUBLISHING CO.
2642 University Ave. St. Paul
Phone Tom Wiggen at 646-2641

Environment continued from page 5

gineering have become increasingly more flexible."

The Environmental Study Group's proposal called for the center to 1) act as a forum in which, for example, proposed courses could be discussed; 2) act as a clearinghouse in relation to research and teaching, for use by potential students and potential sponsors of research and training programs; 3) develop and coordinate a series of seminars on environmental problems; 4) be the logical forum through which interdisciplinary research programs could be developed and coordinated.

In addition to these broad goals, the proposal reinforced the notion that the Center should be a coordinating center and catalyst. The Center is not an academic department and cannot offer degrees, although graduate students may wish to design a minor or supporting program in environmental studies.

Dean Swalin noted that the Center's location in the Twin City metropolitan area provides an excellent research setting. "The Twin Cities can be used because it is an ideal, isolated laboratory. On the east coast, where the cities are so closely tied together, it is difficult to tell one city's smoke from the rest. As it turned out, I was surprised to learn, there's a lack of basic data on what's going on and how things are affected. Among other things, the first step in solving environmental problems will be to collect basic data, and then we can try to use a modelling approach to see how systems are interrelated."

He went on to explain the role of the IT Center for Studies of the Physical Environment in relation to the rest of the university. "Subsequent to the formation of our study group, the Intercollegiate Committee on Environmental Studies, with John Borchert as chairman, was formed to look at what the university should do. Rather than waiting to see what came out of this, we decided to push on with our own center." And, as he noted, it may turn out that each college will go its own way with a university-wide group acting as an umbrella coordinator.

Interdisciplinary education activities and research in environmental affairs will be emphasized in the University of Minnesota, Institute of Technology, Center for Studies of the Physical Environment said its director, Dr. Dean E. Abrahamson.

Abrahamson emphasized the presense of existing environmental courses, yet he hopes to see more courses in operation by this spring or, certainly, by next year. This will be enhanced by the possibility that the Institute of Technology, rather than departments will offer these courses. He also wants to see their application toward major degree requirements or electives.

While Abrahamson is unaware presently what the new courses and programs will offer, he reviewed the possibilities: they could be directly pollution related courses, organized, for example, around air, water, and waste management; they could discuss the sources of pollution, how it behaves, and its implications; or they could discuss pollution by activity, such as the effects paper mills, towns, and power plants have on the environment.

While the Center is not a degree granting institution, and only departments at present can offer courses, the Center's advisory committee hopes to see graduate students using the Center for minor or supporting programs.

The proposal for the Center, as approved by the University Regents last summer, calls for it to act as a coordinator for those aspects of the teaching program which relate to environmental studies.

Abrahamson noted that if the Center directly supports courses, support money must be found, allowing the departments to hire additional faculty for the increased teaching load. One possibility is the Educational Development Fund which the University administration organized for developing and improving courses, teaching methods, and materials.

Dr. Abrahamson also favors expanding the work-study program to companies and government agencies that work with environmental affairs and discussions have already begun with state agency directors.

In an effort to reach more students and the general public, the Center, with the Union Board of Governors, is sponsoring a speaker program. Plans for speakers are being made, and an effort will be made to keep the speakers on campus for several days to discuss further their specialties with interested students and faculty.

In a wider role of public education, Abrahamson hopes the Center will

Continued on next page

Continued from page 28

become a clearinghouse for public inquiries and requests about the environment, "If we can't answer the questions, we will be able to refer them to people who are qualified to answer; we want to serve as a resource center to other educational institutions in the state."

As another help to students, Abrahamson hopes to establish an environmental studies reading room which will not only handle books and periodicals, but will attempt to promptly display newsletter, congressional and agency reports, and notices of impending meetings—items that libraries cannot process quickly enough to be useful. Reserve reading books for environmental affairs courses which might otherwise be scattered throughout the campus library system will also be kept here for use.

The proposal for the Center calls for it to be a forum through which interdisciplinary research programs are developed and coordinated. Abrahamson wholeheartedly agrees with this view, "One has to draw on resources already here. The researchers need recognition and we can help facilitate interdisciplinary research; we can put people in different schools and departments in touch: this is a function the Center can handle."

Since the Center will be acting as a coordinating body, one responsibility is soliciting money for proposed research programs. While the university might support teaching programs, money for research must come from other sources. According to Abrahamson, while some research projects can be supported by the graduate school, agencies like the National Institute of Health, the Department of Public Health, the Pollution Control Agency, and the Metropolitan Council, and private sources will have to be approached for more ambitious projects.

The Center especially encourages interdisciplinary research with an eye toward describing long and short term effects of technologies and systems. Abrahamson feels objective research must cover all aspects of a particular environmental problem.

Dr. Abrahamson and others in environmental studies see a need for complete study of problems, "Engineers have to take into account the total system they're working on. People are good at their own thing, but not at what its use will mean. For instance, the design of a new mining-smelting operation must take into account the economics, population increase, the pollution, transportation systems, etc."

Research is one solution, but it will not have an immediate effect on problems as will expert testimony before regulatory groups. Abrahamson encourages university staff participation in current decision making processes. "For instance, in the Pollution Control Agency, there are often decisions that need to be made involving technical questions. Increased participation by university people faculty and students could help clarify the issues. Historically, this has not been the university."

Abrahamson encourages close ties between the agencies and the university and hopes to get the two groups talking, through students on the work-study program, through asking agency directors to join the Center's advisory committee, and through encouraging increased faculty participation.

Above all, Dr. Abrahamson does not want to see technology abandoned due to an over reaction to the environmental crises; he wants to see it used properly to find complete, technical, social, and political solutions.

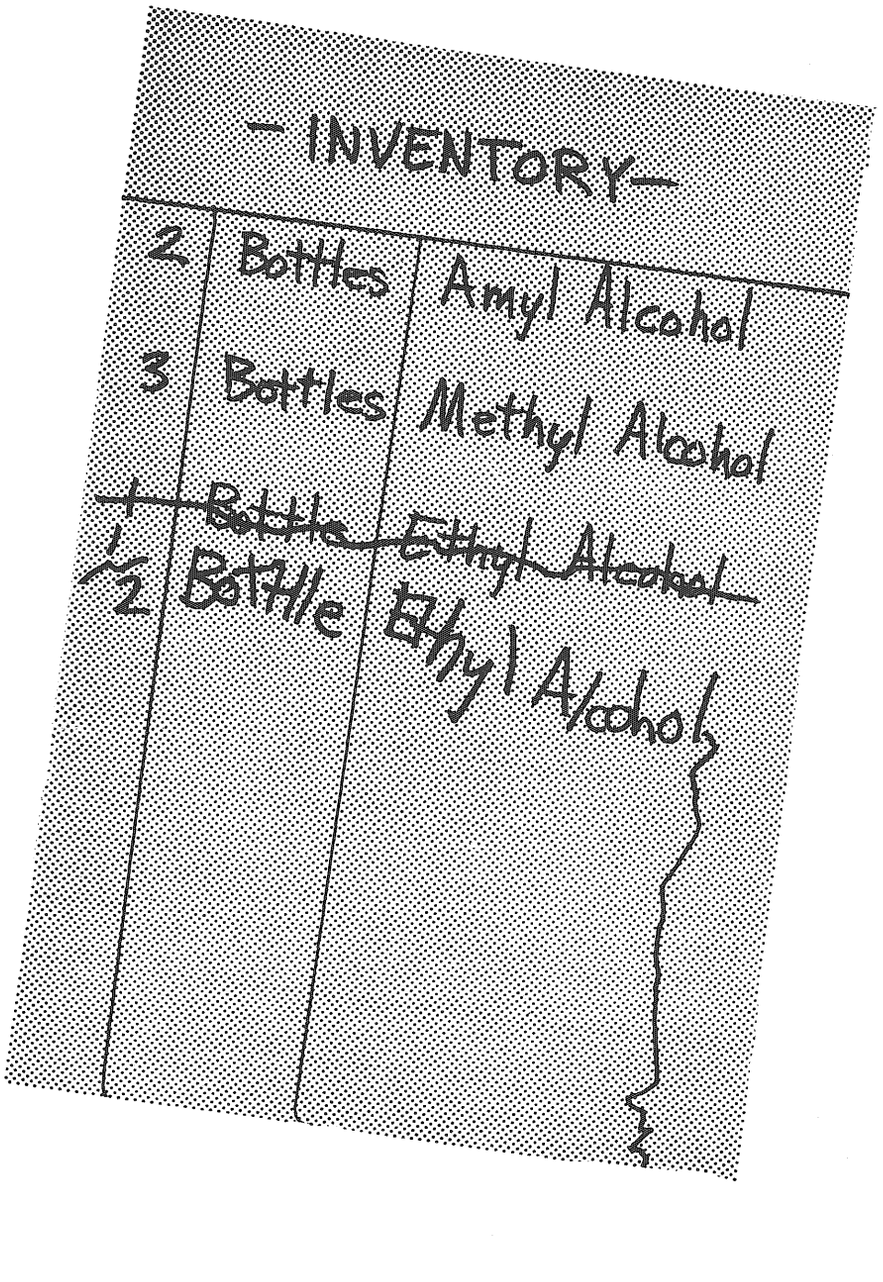
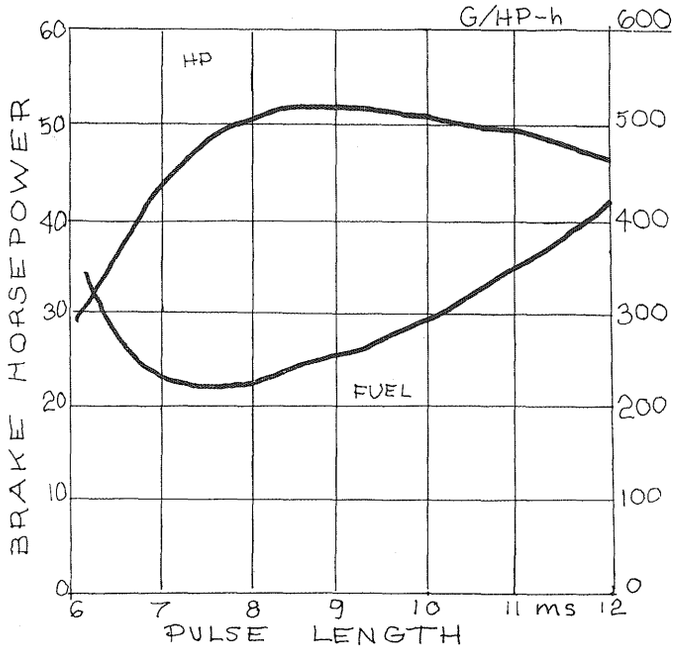
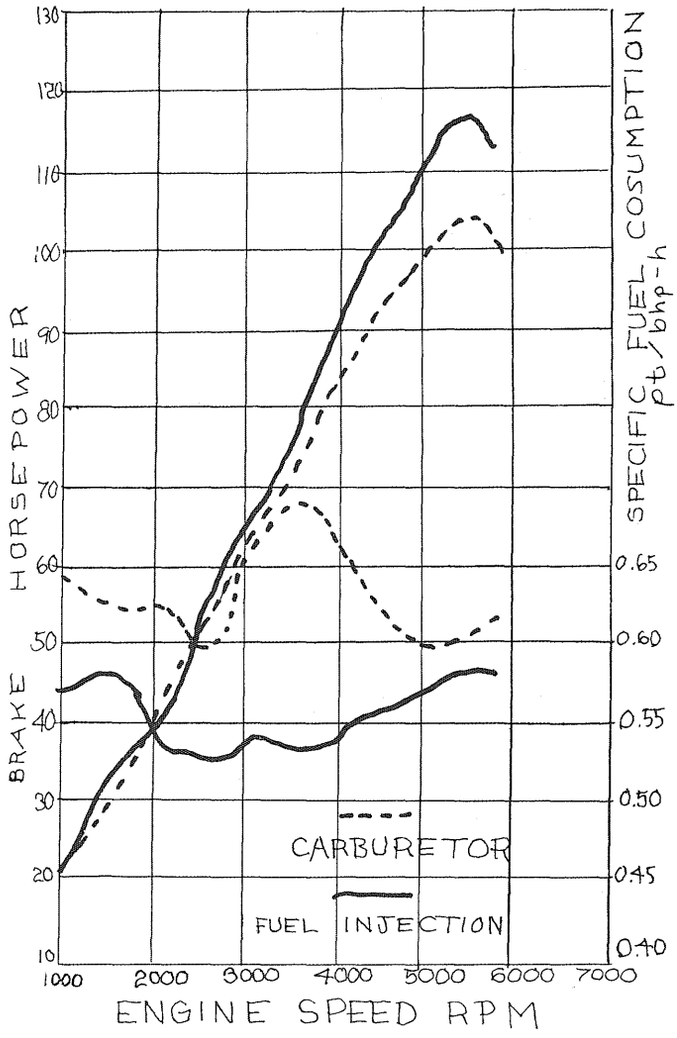


Figure 6. Right: This graph is a performance comparison of carburetion vs. fuel injection on the same engine.

Figure 7. Below: Performance curve of a VW type fuel injection.





Fuel Injection cont. from pg. 21

All manufacturers do not claim large increases in power output with electronic FI as compared with efficient multi-carburetor installations. In addition to reduced noxious exhaust emissions however, increased torque and considerable fuel economy are the main features. Engine response at low speeds is also better. A VW can be driven in top gear at a speed of 15 m.p.h. with two people aboard. 'Punching' the accelerator yields nothing but smooth acceleration.

Present and future exhaust emission control laws call for a more efficient engine induction system. Electronic fuel injection offers an efficient means of meeting this need. Fuel economy, low carbon monoxide-hydrocarbon emissions, and fully automatic control are the main features of this system. Electronically controlled fuel injection is the most feasible way to meet exhaust control laws. It is also important to the future of the internal combustion piston engine.

Four electronically controlled systems are examined in this article. Their general operation, sensor and control details, and design criteria will be reviewed. The claims made about the systems are verified by design curves in the accompaning graphs. Complex systems offer operation which is adjustment free and safe. Transient operating conditions are automatically compensated for by the controls. Signals of the engine speed, temperature, and manifold pressure are given to the computer which in turn varies the amount of fuel delivered to the engine. The computer is programmed from developmental data to operate most efficiently for all varieties of conditions which the sensors see. Automatic control produces safe, convenient operation and does it all while meeting standards of exhaust control laws.

Conclusion

Electronically controlled fuel injection has proven to be a superior all-around induction system to either mechanical FI or carburetion. Complete automation of the control of injection means greater efficiency and performance. Present and future laws concerning exhaust emissions dictate the need for cleaner exhaust. Electronic fuel injection will deliver clean exhaust at a higher efficiency than a normally aspired engine with add-on devices to control emissions. Besides reduced CO and HC concentrations, electronic FI features improved full economy (compared to carburetion) and smooth and efficient operation. Future laws may be based on total output of pollutants per vehicle mile rather than the current proportional basis. Therefore, electronic FI is important to the future of the internal combustion engine.

Splinters

—vilitas et crudas semper eternam

by BARRY JOHANSEN and RALPH POLKINGHORNE

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

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

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

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

• • •

The priest and the rabbi met on the train and as the trip continued, they struck up a conversation. As the friendship developed, the priest asked the rabbi if he would object to answering a rather personal question. The rabbi replied, "No."

"Well," the priest continued, "as part of your religion, you are forbidden to eat ham. True?"

"Yes, that's correct," replied the rabbi.

"Well, Sir," asked the priest, "Have you ever eaten any ham?"

"Yes, I have, Father," answered the rabbi, "and would you mind if I asked **you** a personal question?"

"No, go ahead."

"As a priest, you are required to take a vow of celibacy. Have you ever broken that vow, Father?"

The priest hesitated for a moment and then replied, "Yes, once when I was much younger I did."

The rabbi thought for a moment and then commented, "Sure beats ham, doesn't it?"

• • •

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

• • •

Hear about the deodorant called Vanish? It makes you disappear and everybody wonders where the odor is coming from.

I serve one purpose in this school,
Upon which no one can frown.
I quietly sit in every class,
And keep the average down.

• • •

Diary of a young lady taking first ocean voyage:

Monday: I felt highly honored for being placed at the captain's table.

Tuesday: I was on the bridge with the captain. He seems to like me.

Wednesday: The captain made proposals unbecoming to a gentleman and an officer.

Thursday: The captain threatened to sink the ship unless I agreed to his proposals.

Friday: I saved six hundred lives today.

• • •

Do you know the definition of a redhead—A communist outhouse.

The GI.s were searching a village just after a battle of WWII. Entering a large house they found a coffin in the middle of a room. Opening the coffin, they found an old grey haired man madly erasing a musical manuscript. When questioned who he was and what he was doing, the old man replied: "I'm Beethoven, and I'm decomposing."

• • •

Seville Derdago
Tousin Busis inaro
Nojo demis trux
Summit cousin
Summit dux.

• • •

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

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

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

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

MORE SPLINTERS . . .

"Wanna sell that horse?"

"Sure I wanna sell the horse," the farmer replied.

"Can he run?"

"Are you serious? Watch."

The farmer reached over and slapped the horse on his posterior and the animal went gallopng away. As the horse reached full speed, he ran smack into a tree.

"Is he blind?" the buyer gulped.

"Hell no," the farmer said easily, "he just don't give a damn."

• • •

The following is a report on the approach taken by various types of students:

Pre-Med: "You wouldn't care to come with me, would you?"

Art Student: "Would you care to come with?"

Engineer: "Lucky girl, where are you taking me?"

• • •

Joe was playing his usual 18 holes of golf Saturday afternoon. He had just sliced into the rough off the 17th tee and was about to chip out when he noticed a long funeral procession going by on adjacent street. Joe removed his cap and stood still until the funeral passed. Later at the club house, a fellow golfer greeted Joe.

"Say, that was a nice gesture you made today, Joe."

"What do you mean?"

"I mean it was nice of you to take off your cap and stand respectfully when the funeral passed," his friend explained.

"Oh, yes," said Joe. "We would have been married twenty-six years next month."

E.E.: "I'm just not feeling myself tonight."

Coed: "You're telling me?"

• • •

After a shipwreck, a woman was floating on a raft with a parrot. After several days of silence, the parrot spoke:

"How's your fanny?"

"Shut up, you stupid bird."

"Mine too," replied the parrot. "Must be the salt air."

• • •

Forester: "I have a splinter in my finger."

Engineer: "Been scratching your head?"

• • •

The year is 2001, and the Martians have taken over the Earth. One of their foods is human brains. So Zip, a hungry Martian, went down to his neighborhood grocery store to buy a pound of brains.

Zip: "What ya got for brains today?"

Grocer: "We got some Engineers' brains here for $.50 a pound, some Pre-Med brains for $1.00 a pound, and some Forester's brains for $4.00 a pound."

Zip: "Why so much for the Forester's brains?"

Grocer: "Do you know how many Forester's students we have to kill to get a pound of brains?"

• • •

He drove quite a distance into the country, stopped the car and asked the girl, "Are you a Chesterfield or a Camel girl?"

Somewhat confused she asked, "What do you mean?"

He said, "Would you rather satisfy or walk a mile?"

• • •

Skin: "What kind of bees give the most milk?"

Bones: "I don't know, what kind are they?"

Skin: "Boo bees."

• • •

They were about to draft the young mountain girl into the WAC's until she jumped over a camp fire and got defurred.

Kodak

The lively engineer and the fat-cat corporation *or* The recruiter's dilemma of 1971

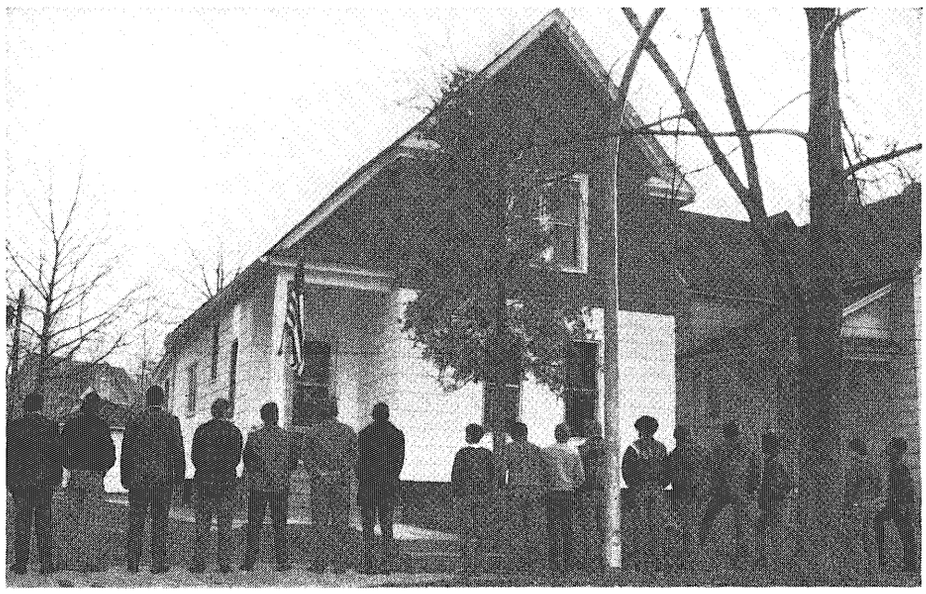
As in any selection process, if you can afford the best and the best is available, you pick the best. "Best" here means the liveliest minds and personalities. And there comes the dilemma: pick them, or pick those who won't rock the boat? On today's engineering campuses there is a scarcity of bright people interested in nothing but engineering. The boat will have to rock a bit. Let her rock. Eastman Kodak Company, Business and Technical Personnel, Rochester, N. Y. 14650. An equal-opportunity employer.

* * *

Dick Pignataro is a mechanical engineer from Georgia Tech. His job has to do with engineering, construction, maintenance, and utilities for the manufacture of film, paper, and chemicals by the most advanced methods available. The office next to his was occupied by a 24-year-old personnel man named Bob Lee.

One night over a beer these two under-30 types were getting themselves worked up over the contrast between life as lived a mile or two outside the plant gates and the sleek technology inside those gates. Instead of letting it drop, they put together a proposal for rebuilding badly decayed houses. It called for high-grade Kodak talent, Kodak seed money, and faith in the premise that kids can hate school and yet take pride in doing a job right. Seemed like puddin'-headed humanitarianism unlikely to get very far up the chain of command.

Three weeks later, high aloft in a jet, their idea was being explained to the company president. He liked it.



Pignataro, Lee, Kodak construction supervisors, and young men of Rochester, N. Y., admire house the young men rebuilt. The first year several dozen such houses are being rebuilt by a work force of 100 part-time students. Since interest in the sonnets of Shakespeare is at present negligible among these students, their studies tend more toward figuring how many boxes of tile to order for a 9' x 13' kitchen floor. Building-trades unions counsel. So do bankers, realtors, and schoolmen. The renovated homes are sold to poor people at prices they can afford. It is better to light a candle than to curse the darkness. If the candle is too dim, try a halogen-vapor lamp.

When you can hardly hear yourself think, it's time to think about noise.

Noise won't kill you. But before it leaves you deaf, it may drive you crazy.

Noise is pollution. And noise pollution is approaching dangerous levels in our cities today.

People are tired of living in the din of car horns and jackhammers. They're starting to scream about noise.

Screaming won't help matters any. But technology will. Technology and the engineers who can make it work.

Engineers at General Electric are already working to take some of the noise out of our environment. One area where they're making real progress is jet-aircraft engines.

Until our engineers went to work on the problem, cutting down on engine noise always meant cutting down on power. But no more.

GE has built a jet engine for airliners that's quieter than any other you've ever heard. A high-bypass turbofan. It's quieter, even though it's twice as powerful as the engines on the passenger planes of the Sixties.

And NASA has chosen General Electric to find ways of cutting engine noise even further.

It may take an engineer years of work before he can work out the solution to a problem like noise in jet engines. And it may be years before his solution has any impact on the environment.

But if you're the kind of engineer who's anxious to get started on problems like these and willing to give them the time they take, General Electric needs you.

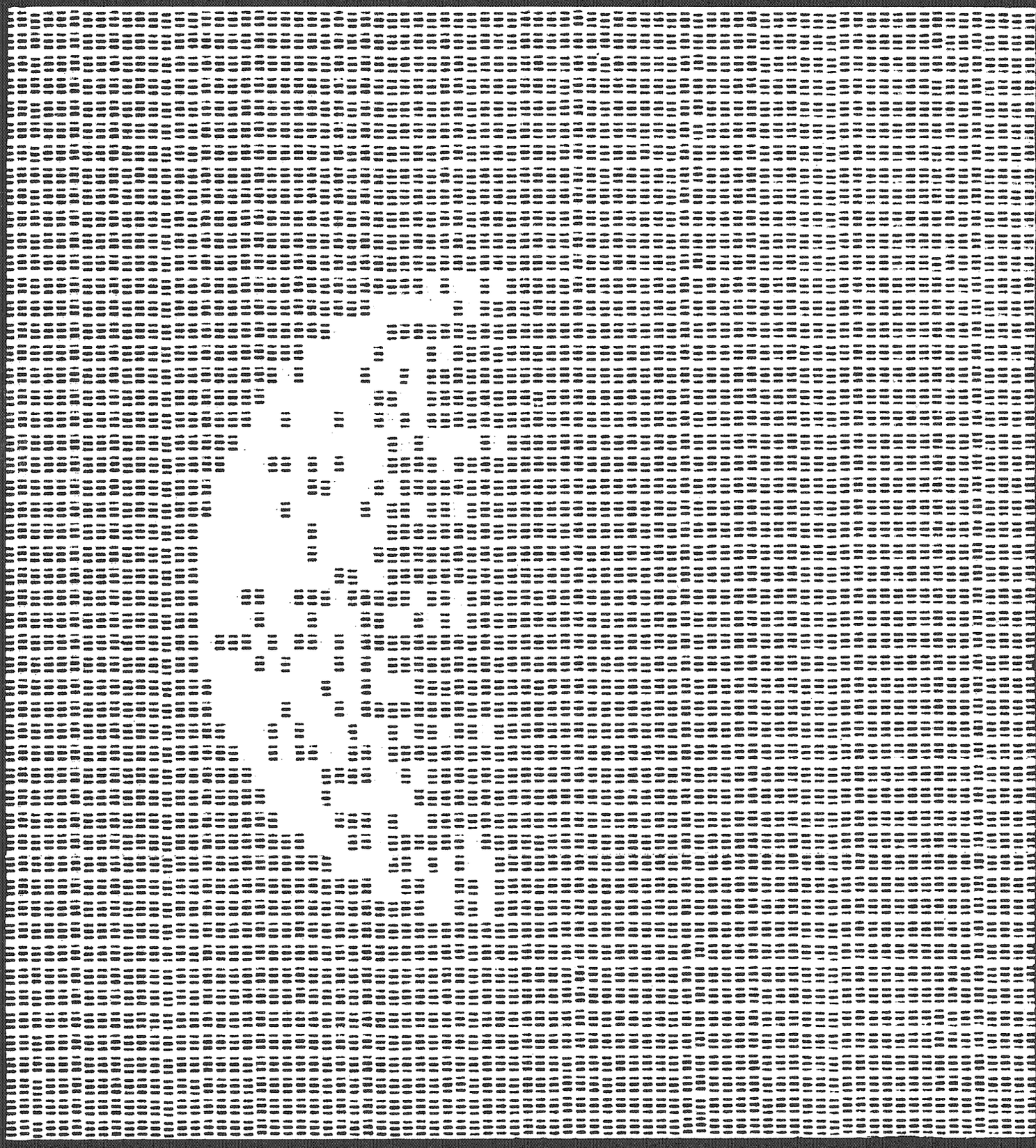
Think about it in a quiet moment.
Or, better yet, a noisy one.

GENERAL ELECTRIC

An equal opportunity employer

TECHNOLOG

UNIVERSITY OF MINNESOTA MARCH, 1971

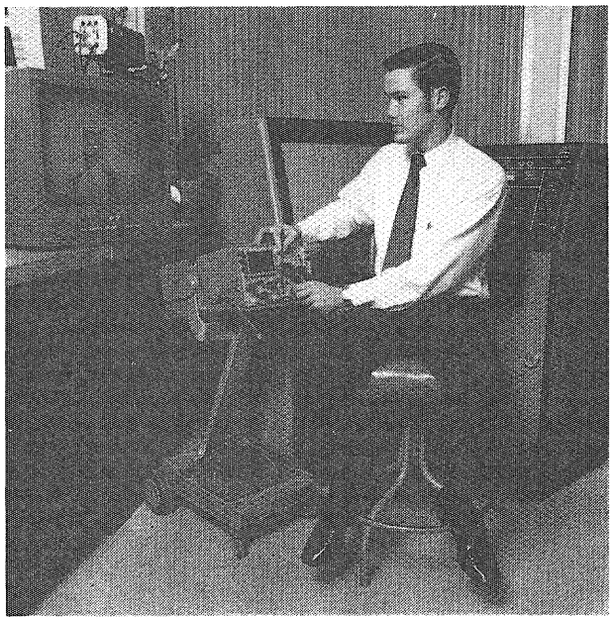


"They encourage us to look for original solutions to problems. This sparks inventiveness."

Bill Greiner, Western Electric

Bill Greiner's problem: shaving 10-14 seconds off one operation in the manufacture of integrated circuits, while reducing error factor below .001 inch.

Bill is a staff member at Western Electric's Engineering Research Center, working primarily with the handling and testing of integrated circuits.



Bill came to Western Electric in 1968 after receiving his MS from MIT. He earned his BS in Mechanical Engineering at Yale.

"My work here has given me a better appreciation of the problems in manufacturing," said Bill. His automatic TV system for the alignment of integrated circuits is a good example.

At one phase of the manufacturing process, operators must correct alignment of integrated circuits by hand—a job that took up to fifteen seconds, and was accurate to only .001 inch in x and y, and to one degree in rotary.

What Bill did, essentially, was design and build a small dedicated computer that completely automates the process. An operator can push a button to align the integrated circuits automatically. A TV camera enlarges the image in silhouette form, scans the pattern, and feeds the voltage signal into Bill's computer. The computer calculates the position measurements and triggers a stepping table to correct the alignment.

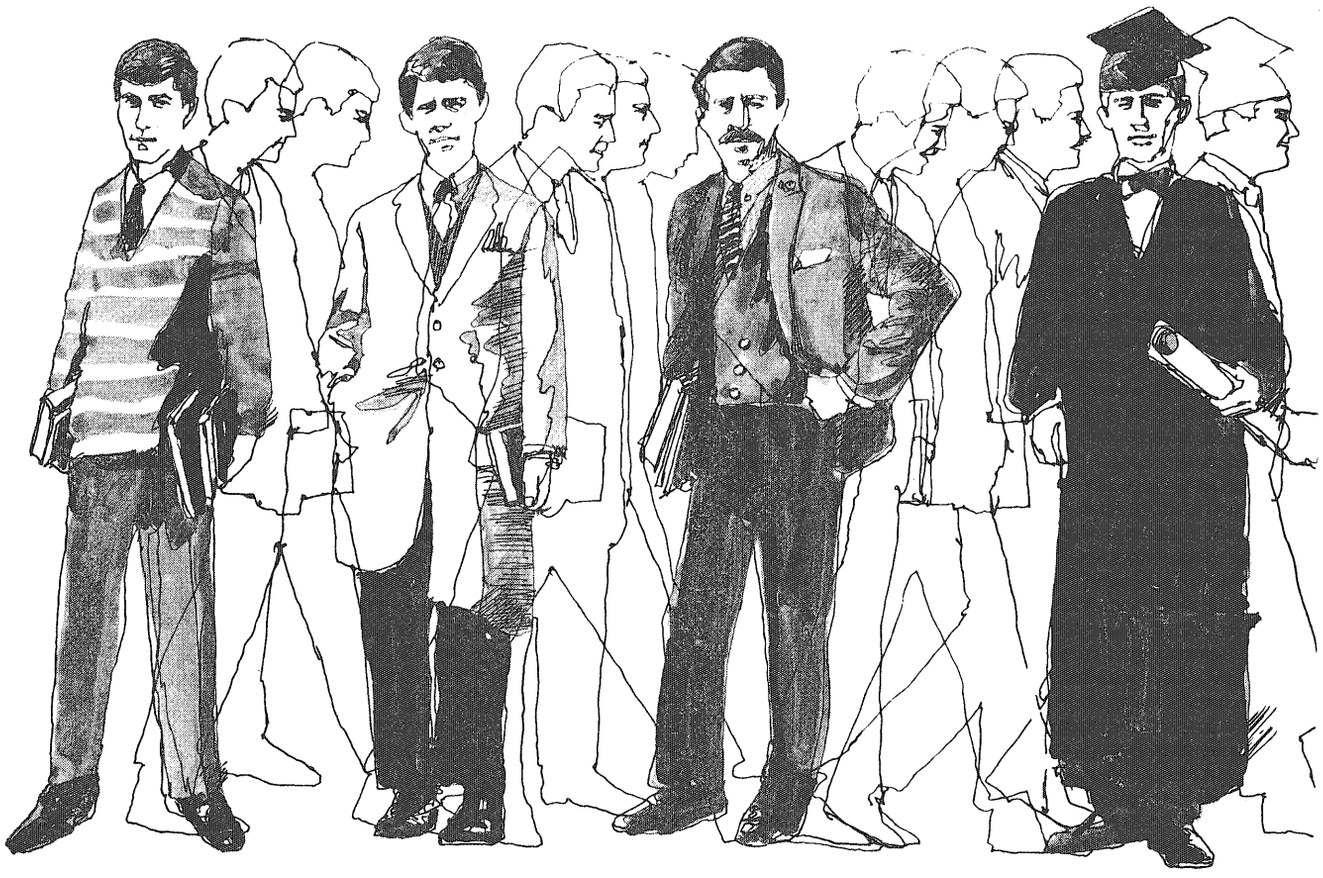
The correction time is reduced to one second, the error factor to .00025 inch in x and y, and ½ degree in rotary.

Bill finds the challenge of electronics and logic design extremely stimulating. "We're not channeled: we have a chance to get involved in a variety of fields."

What does he find most satisfying about his job at Western Electric? "Well," said Bill, "I look for an amount of responsibility. And here I'm encouraged to take it."

Western Electric

An Equal Opportunity Employer



Senior!
While you were in college, Westinghouse built 13 new plants, boosted sales $1 billion, got 2,000 new patents.

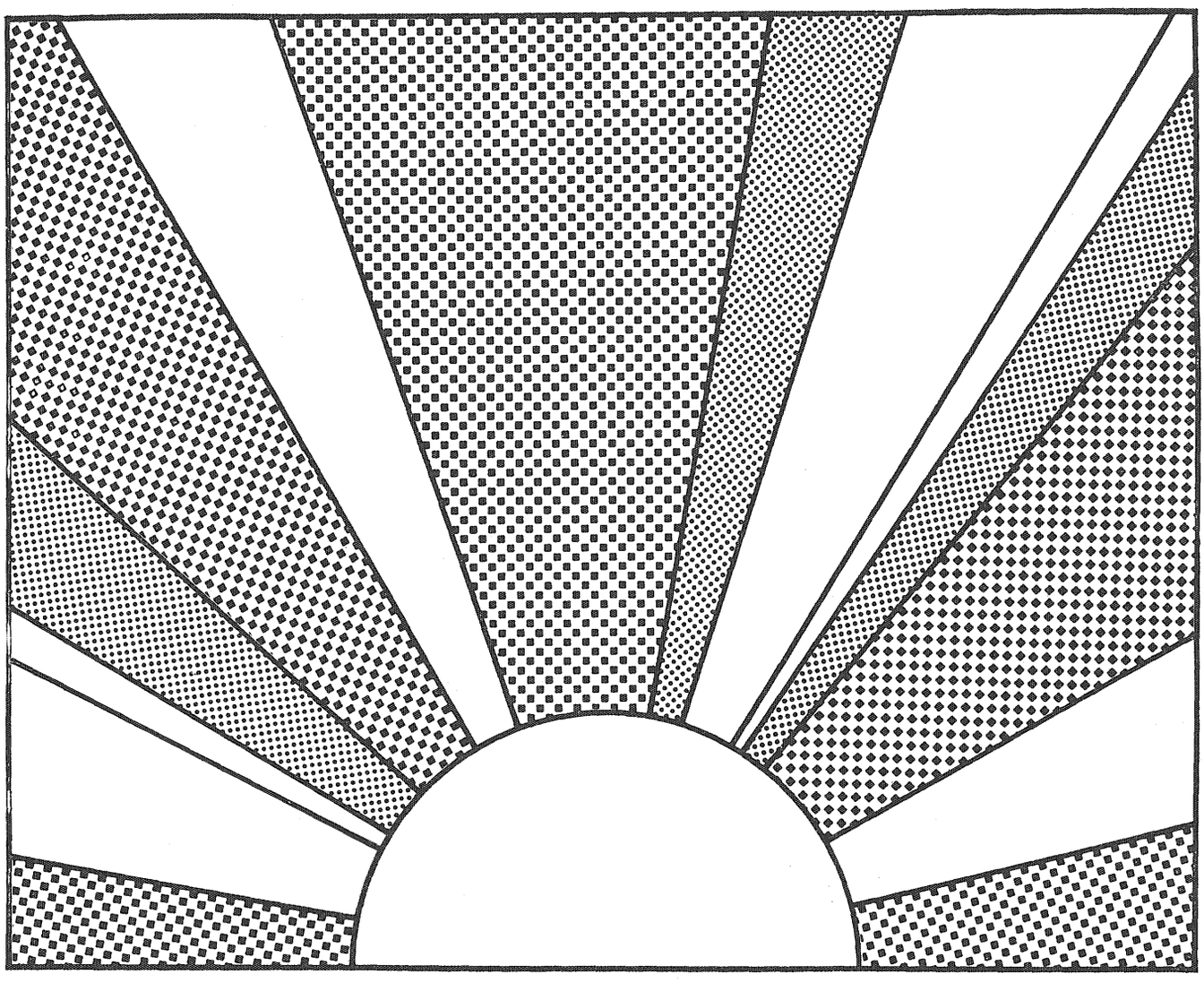
Nice growing figures. But maybe the figures aren't as important as the areas we're growing in:

Housing, mass transit, health care, education, crime abatement, urban development, pollution control, nuclear power, oceanography, computer-based information systems.

Talk with our campus recruiter. We're looking for engineers to grow with us. Electrical, mechanical, chemical, industrial. And finance/accounting people.

If you can't wait for the recruiter, write today to Luke Noggle, Westinghouse Education Center, Pittsburgh, Pa. 15221. An equal opportunity employer.

You can be sure...if it's Westinghouse



Guaranteeing clay pipe is like guaranteeing the sunrise.

Our 100 year guarantee* on clay pipe is almost unnecessary. Because clay pipe's durability is as certain as the rising sun.

Aren't we overstating our case a little?

Not at all. Clay is one of those rare substances that nature made virtually incapable of being corroded or chemically broken down.

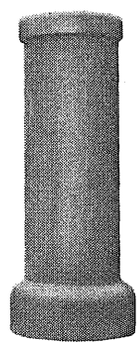
Clay is formed after sun and rain and sleet and snow have beaten away at the earth for thousands of years. When the earth's crust can't be broken down any further, all that's left is a layer of virtually indestructible material. Clay.

Of course, nature doesn't work cheaply. So clay pipe costs a little more than pipe made of cement bonded materials or synthetic plastics.

But what a difference in performance. While you can expect other pipe to last about 5 or 10 years, clay pipe has continued serving in wastewater systems all over the country for generations without any kind of breakdown.

That's why makers of other kinds of pipe seldom guarantee their product for any specific length of time, while we guarantee clay pipe for 100 years and know it's an understatement.

If you want to make sure the pipe in your wastewater system lasts, make sure it's clay. The toughest pipe material under the sun.



W.S DICKEY *Clay Manufacturing Company*

Kansas City, Missouri; St. Louis, Missouri; Lehigh, Iowa; San Antonio, Texas; Birmingham, Alabama; Meridian, Mississippi; Texarkana, Texas-Arkansas

*Dickey Clay will supply—free of charge—replacements for any clay pipe which has been damaged, destroyed or impaired in service for a period of 100 years from contract date, if damage has been caused by corrosion or other chemical decomposition from acids, alkalis, sewage or industrial wastes (except Hydrofluoric Acid) or damage by rats or other rodents whether pipe is used for industrial, residential or general drainage purposes. Damage from improper handling, placement or trench loading is not covered.

TECHNOLOG

VOL. 51, NO. 6 | Official Student Publication of the Institute of Technology, University of Minnesota | MARCH, 1971

FEATURES

DEPARTMENTS

THIS MONTH'S COVER was produced by a computer program, ART II, by Ron Reichenberger. See Technology in Art on page 10 for more about the program.

MEMBER OF ECMA

Published monthly, October through May. Second-class postage paid at Minneapolis, Minnesota. Office: Room 2, Mechanical Engineering Building, University of Minnesota, Minneapolis, Minnesota 55455. Telephone: 373-3298. Printer: Bruce Publishing Co., 2642 University Avenue, Saint Paul, Minnesota 55114. Publisher's National Representative: Littell-Murray-Barnhill, Inc., 369 Lexington Avenue, New York, New York 10017 and 737 North Michigan Avenue, Chicago, Illinois 60611. Publisher's State and Local Representative: University Engineering Magazine Advertising, F. P. McGrath Manager, Box 14026 University Station, Minneapolis, Minnesota. Telephone 612-225-0708. Member of the Engineering College Magazines Associated, Gordon Smith, Oklahoma State University, Stillwater, Oklahoma. Subscription rate: $4.00 per year, single copies 50 cents. Advertising rates upon request. Any opinions expressed herein are not necessarily those of the Institute of Technology or of the University of Minnesota.

THE MINNESOTA MINORITY

by John M. Huggins

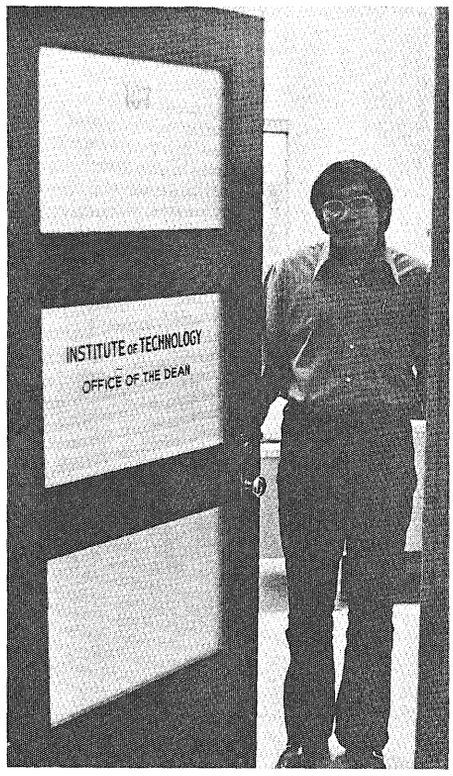
The fields of science and engineering represent perhaps the most accessible route, within the system, from the blue collar to the white collar socio-economic categories. It could be said that unlike the more tortuous paths from lower to upper economic strata, enginnering is truly the freeway. A technological society such as ours requires a continuous supply of well trained scientific minds to keep things going.

It is of economic necessity that corporations draw from the pool of scientists and engineers without regard for social or economic background, or so it seems. This is what we have been led to believe; and in a sense it is accurate to say that in engineering, the most technically competent will be in the highest demand. The rugged competition for technological innovations thus insures that an aristocracy will never exist in the sciences.

Why, then, is Engineering lily-white? And it is, you know; last year less than 1% of BS graduates in engineering were Black. It is even worse than that on a local scale. Despite the fact that Minnesota has a relatively large American Indian population in addition to the urban Black and Chicanoes, the combined enrollment of these three groups account for less than one-third of one percent of the undergraduate population in IT. That is to say you could get them all into a phone booth and still not break any records.

There appears to be an inconsistency somewhere. On the one hand, we can argue that the lower economic strata are the obious beneficiaries of our technocracy, yet it is precisely these minority groups, who constitute Minnesota's lowest economic stratum, who find the professional technical work force impenetrable.

Question: To what extent, then, is engineering the great equalizer?



The door is opening

Answer: To the extent that all segments of our society have equal access to the high quality education prerequisite for a professional technical career. And that access has little to do with open admissions. Most minority groups have been denied access to this high quality education long before they reach college age. By the time the bright minority students begin aspiring to an engineering career, they are seriously deficient in the basic skills which the middle class student can take for granted.

They can be, and frequently are, admitted on the basis of their aptitudes, only to find themselves in over their heads academically because of their poor preparation. Unable to compete in a curriculum designed with the white middle class student in mind, they drop out to become the non-contributory members of society they had feared all along they would become.

So until such time as we can provide the bright Indian student with a substantial background in communication skills; until the intelligent black student from the inner city school comes to us with the same reading proficiency as the rural Minnesota graduate, we can expect this inequity of opportunity to continue within our community.

In recognition of these problems, a number of programs have been funded, and are being implemented with our community and University at the present time. One program, Project Technology Power, is designed to recruit and retain minority students within IT. Getting them here frequently requires some sort of financial aid. It occasionally requires slight modifications in the entrance requirements. However, no student is admitted who has not demonstrated the aptitude required to survive the rugged IT curriculum.

Keeping them here is another problem. The students are encouraged to live in the IT houses in the dorms for a number of fairly obvious reasons. That requires money, however, and the local students usually end up living at home. The normal academic support programs available to all IT students serve as the primary source of tutorial help. The minority students are strongly encouraged to use these programs.

Dr. Jack Moran, the Project administrator, has a number of additional proposals which, if funded, should improve the retention rate. New courses will be developed to help ease the transition into the rigorous college math sequence, for example. Extended programs will be formalized to permit a lighter course load and/or part time work, while reducing the pressures exerted by the selective service.

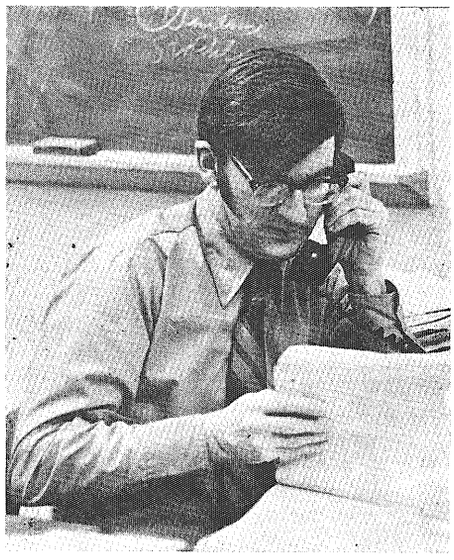
It should be noted that response from the IT faculty to these types of

While other professions appear to be attracting minority people in large numbers, the profession most noted for upward mobility is stalling.

One factor is that while doctors, teachers, and social workers can return to their own communities to work, the engineer must remain in the heart of the white corporate structure.

programs has been encouraging. For example, nearly fifty IT faculty volunteered two years ago to serve as tutors for a group of disadvantaged students. That's about five professors per student this year—not bad! There are programs in progress aimed at high school and elementary students as well, and it is the acceleration of elementary and secondary school programs such as these which could, at some point in the future, produce a minority enrollment somewhat commensurate with the population.

The community, the University, and the Profession all attend to benefit from the success of these programs, which are, of necessity, being implemented on a very limited scale. However, there will be those who are resentful of any program which will, in any way, place the minority student in a privileged position. The truth is that the academic support and concentrated counseling made available to the disadvantaged student (both minority and white), hardly create a position of advantage. They represent

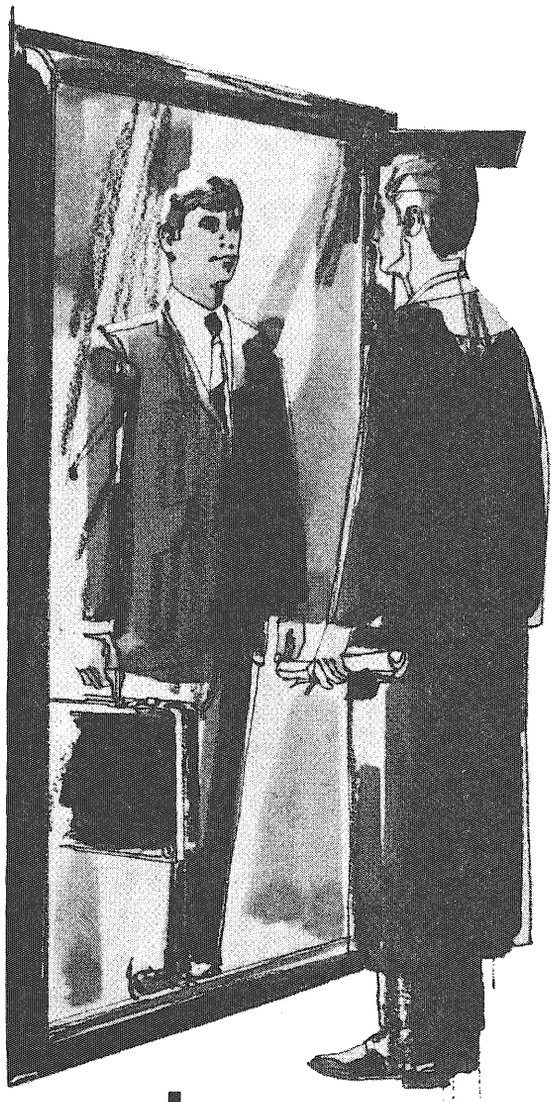


Dr. Jack Moran, Project Administrator

an attempt by the University to serve a segment of our community which has not been able to avail itself of the advantages of higher education.

It should be kept in mind that the focus in this discussion has been on but one facet of a very complex problem. In addition to the inequities in educational preparation and opportunities, there exists a problem of conflicting values as well. A cultural interface exists between the various minority communities and the rest of the state. We cannot expect these proud and distinct cultures to subscribe entirely to our game plan. We must recognize the inequities for what they are: manifestations of a basic misunderstanding—the misunderstanding which comes from a lack of dialogue between segments of our society; and the misunderstanding which results when a dominant culture fails to recognize or respect the existence or the values of a legitimate subculture within it.

We in IT can no longer ignore the problem, even if we can't develop a total solution through our efforts alone. The students of the Institute of Technology should become sensitive to the nature of the problem as it affects us there, on our campus; and we should all be aware of the efforts being made to improve the situation.



discover who you are

...and what you can do.

Explore your talents. Become one of the discoverers in the new Electronic Age. It can all happen at Automatic Electric Company.

Automatic Electric. Largest supplier to the Independent Telephone industry. We are manufacturers of communications products, simple to sophisticated. We sell to industry and to Government as well as to telephone companies here and abroad.

At Automatic Electric your creativity and individuality will receive quick, sure recognition in small project groups. Couple this with the unlimited opportunities that a large company can offer . . . and build a truly challenging future.

The communications industry is growing fast. Why not grow along with us?

We have positions for degreed candidates in these fields:

■ **Electrical Engineering** ■ **Computer Science** ■ **Mathematics**

■ **Industrial Engineering** ■ **Electrical Engineering Technology** ■ **Mechanical Engineering**

SEE YOUR PLACEMENT OFFICE for more information about Automatic Electric Company and Automatic Electric Laboratories. Or, write Mr. Robert J. Diana, Coordinator of College Relations, Automatic Electric Company, 400 North Wolf Road, Northlake, Illinois 60164.

AUTOMATIC ELECTRIC
GENERAL TELEPHONE & ELECTRONICS

An Equal Opportunity Employer

LOG'S LOG

by Ace & Zeus

Introduction

O joy supreme! Spring is on its way. This bit of information was passed along to Ace and Zeus last week by Toivo Twofeathers, our Polack meteorologist. Of course the E-F Team demanded to know how he had ace-ertained this fact of ecstacy. Toivo said, "Ye sure, when the squirrels around the Union start digging for their nuts and mating, then I guess Spring might be coming." Then he added, "But when these same creatures start demonstrating, then I am positive spring is here!"

Lush's Cornernerner

Business has been getting bad for Bruce these days —so bad that he's had to resort to drastic measures; "thinking" (and you know how painful that is).

The E-F Team tried to shed some light on the problem for Bruce, but he beat us to the switch. Bruce's Bar and Body Shop is now Bruce's Third Rate post-Television Triple Re-run Movie Palace and Refreshment Center. In order to keep his new image Bruce has even given up drinking (similar to Dracula giving up blood).

So, while the E-F Team settles down to the seventeenth showing of "Tweetie Pie meets King Kong at the Bridge over the River Kwai," we bid you happy sipping (or slurping) Bruce's latest, "The Bloody Birdie or the Hen-Pecked Ape": one part vodka to two parts cranberry juice, with lots of ice.

Ace's Advice for the Month

This month Ace's Advice advises all of you peons how to find your advisors in order to get some advice. (Whew!)

Zeus and I undertook this top-secret mission at the peading of Irving M. Ahd, a professional student in IT. I. M. Ahd's goal is to receive a degree in every field, so when he hadn't been able to locate his advisor after sixteen years, he came to the E-F Team for help. The following trivia is what the illustrious E-F team has discovered.

First of all, advisors are totally unique. The best place to look for yours is in the least likely place. If he's an Eskimo, then look for him in the tropics. If he were a fish you'd probably find him in Death Valley. A frosh here at the Log Office, Ikik, found hers in Timbuktu!

Secondly, don't believe his office hours. Many advisors don't change theirs every century as they should. If the note says to come at 1:00 p.m., come at 1:00 a.m. Your luck couldn't be much worse.

Thirdly, distrust any note which says he will be right back. It is rumored that one poor fellow has been patiently waiting for three months outside of EE 31 for his advisor to return. (Lotsa luck, fella.)

Lastly, ignore any and all "Do Not Disturb" signs. More than likely, this is the only time you will be able to catch him.

In case you still don't have any ideas of how to get a hold of your adviser, inspect the following true to life examples.

When I need him most, my adviser is . . .

In France
At the Big Ten
In the hospital
Confined to Moose Lake,
or St. Peter
at Maggie's Midnight Sauna
and/or Hiding in the steam tunnels

Cir Noslo, another token frosh, has an adviser who hides in the weirdest place of all—his office. Yours truly, Ace, still doesn't believe it. As for Zeus, well, he hasn't come out of shock yet!

Official Daily Bull

Due to circumstances beyond our control, next month has been cancelled. However, if we are overruled and March does occur you will unfortunately be able to read this.

March 15-31

15—Caesar's Day. Try not to get cut.

17—Drunks' Day. Engineersh cut shamrocksh. Sham doesn't like thish, tellsh them to kissh Blarney'sh shtone.

20—Hockey Day. Time to get the puck out of here.

April 1-15

1—Lirpa Sloof Yad. Enizagam semoc tuo no emit!

6—Street Cleaner Day. Curb thy thoughts.

10—Zeus Day. He's the Greek god with the Roman hands and the Russian fingers.

Conclusion

You know, it's really amazing, how, for every occasion there's always a smart ace (loved about as much as wet toilet paper or warm beer) present to make your day a little more miserable. (i.e. the mean on the test is 85 and you have a 40; so-slorry, we just ran out of beer).

Thank goodness there's another side to the coin. I guess my great-grandmother had the right idea when she said, as I was leaving for college for the first time. "Now, be good; if you can't be good, be careful; and if you can't be careful, NAME IT AFTER ME!"

Engineers' Day '71—

We Try Harder

Planning is well underway for the 1971 Engineers' Day coming up May 7th. It goes without saying that the success of E-Day is dependent upon the amount of participation by IT students, so this year a special effort is being made to allow everyone to take part in all of the activities. We will attempt to gain everyone's attention and support for these activities by first promoting a theme that is truely different and has creative potential, and second, by giving you every opportunity to be involved in a wide variety of events. The following paragraphs will, I hope, demonstate our intentions and make you look forward to taking part in this years's E-Day.

It is hoped that the upcoming E-Day theme "Engineering—Then and Now" will inspire new and creative ideas which will make the occasion unique. This theme, and the activities which reflect its tenor, will pay tribute to the past few decades of engineering accomplishments.

The "open house," featuring exhibits by industry and IT departments in the Architecture Court, has always been popular with students and will be brought back after a year of absence. This activity should be especially interesting in view of this year's theme.

This year, more than ever before, the E-Day tournaments will be geared to the participation of all. Besides the usual tournaments of interest to most —softball, tennis, bowling, table tennis, bridge, etc.—we will be scheduling special tournaments such as co-ed volleyball, chess, beer drinking (with several variations), and other surprises.

Of course all the tournaments will be open to all IT students and well publicised for maximum participation.

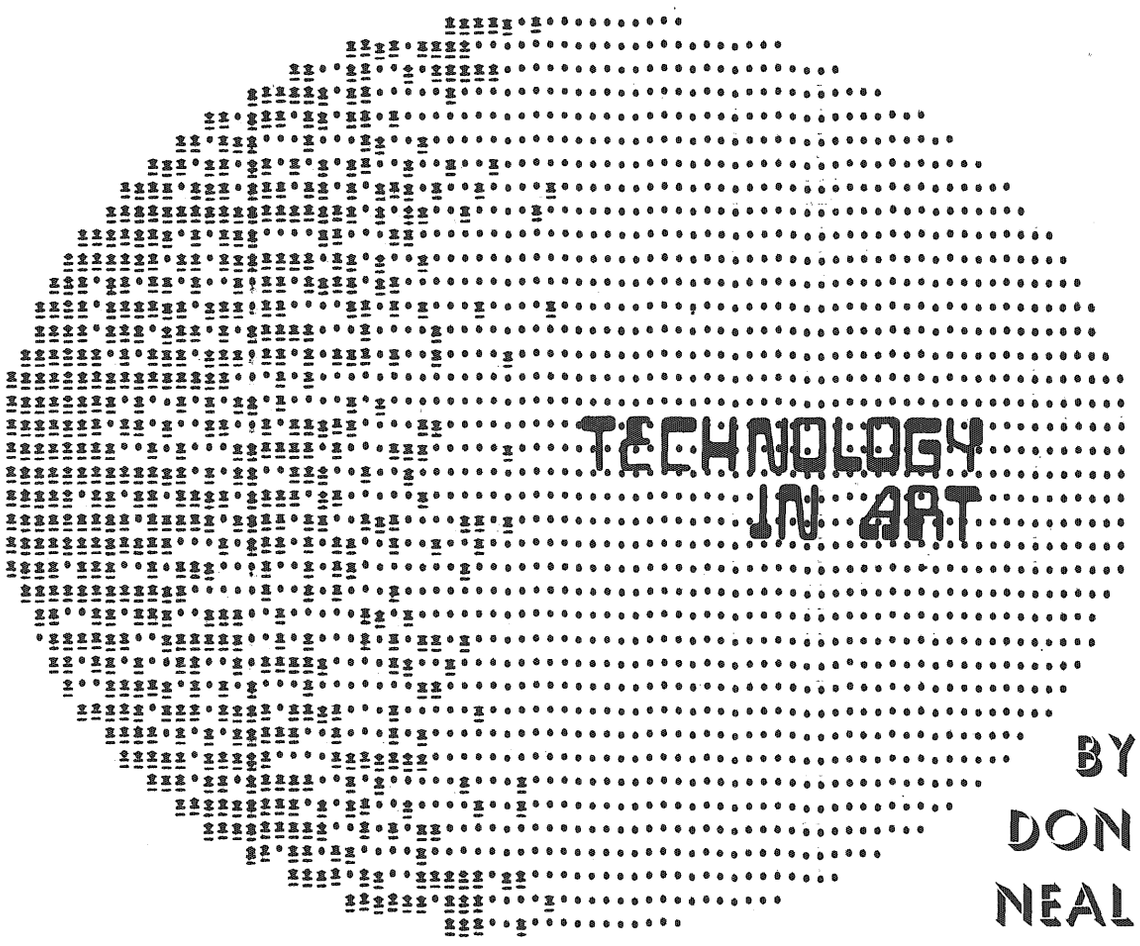
The E-Day road rally, a favorite activity for some, is scheduled for Sunday, May 2. After the rally the "seniors' picnic" may again be held this year.

One of the most popular features of E-Day, the home made car race, will again be held immediately following the parade on the 7th. To promote the greatest safety and fun in this event, the optimum speed of the vehicles for judging will be 10 MPH average. We hope to encourage, in the publicity and judging of the competition, the building of "Rube Goldberg" type vehicles and propulsion mechanisms.

This year's brawl, the culmination and conclusion of E-Day events to be held on the eve of the 7th, will be planned such that more students can take part in this important event. It will probably be an informal, or semi-formal dinner-dance held in Coffman.

All of the E-Day events are being planned for maximum involvement by those for whom the occasion is intended—you, the IT student.

Bruce D. Nelson, Chairman
Engineers' Day, 1971



The background is a shaded ellipse by Don Reichenberger.

Editors Note: The author, Don Neal, is a ME graduate and is currently working on a Bachelor of Fine Arts degree at the U of M in addition to working on the T' Log Staff.

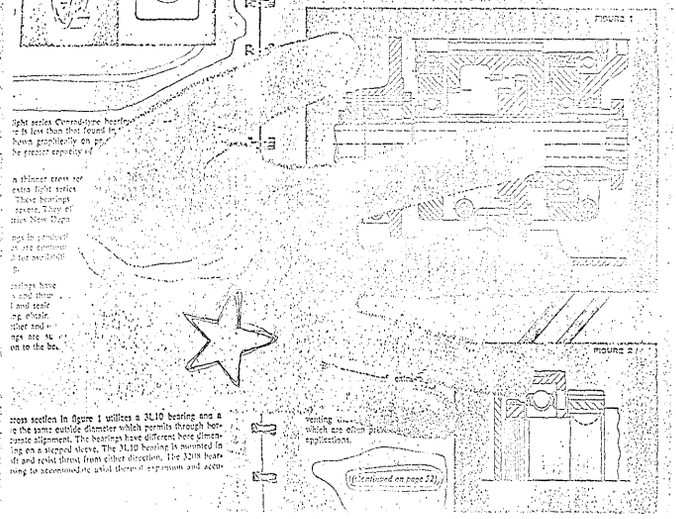
Scientific and business machines are now being used by artists to create works of art. No artist today can ignore the advances of the computer age. They will influence his work and thinking, as all aspects of society have always influenced the artist.

Computer influenced art can be divided into two catagories: Cybernetic devices as works of art, and works of art produced by cybernetic devices. The latter conists of musical compositions, dance choreographies, poetry and prose, animated film and, the subject of this article, computer and other machine generated graphics. All types of software processes and devices are being used by artists. These include electrostatic and photo copy machines, micro film, and computer related equipment.

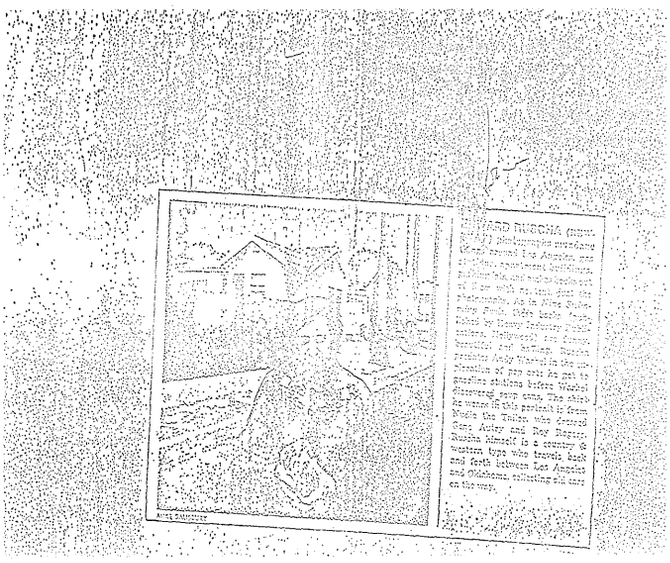
Computer graphics are created by two basic methods: drawing machines,

Continued on page 14.

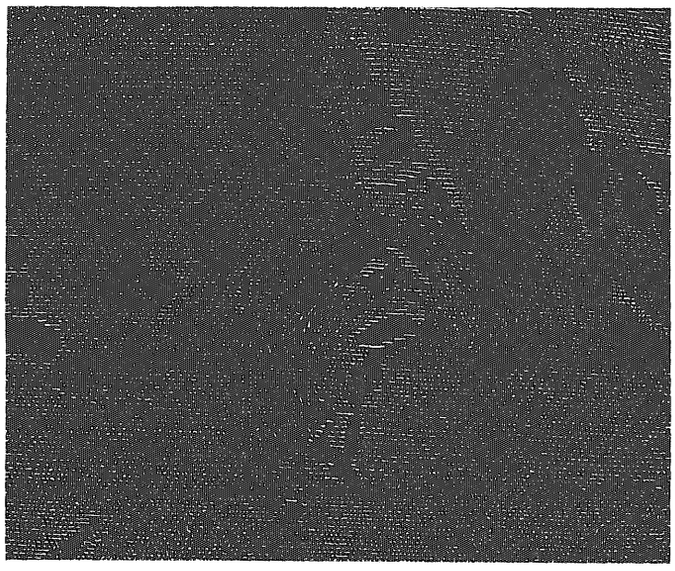
Above: "Hand Sequence 1970" Zerox print by Don Neal



Above: "Bearing Sequence 1970" An original print created on Zerox machine by Don Neal.

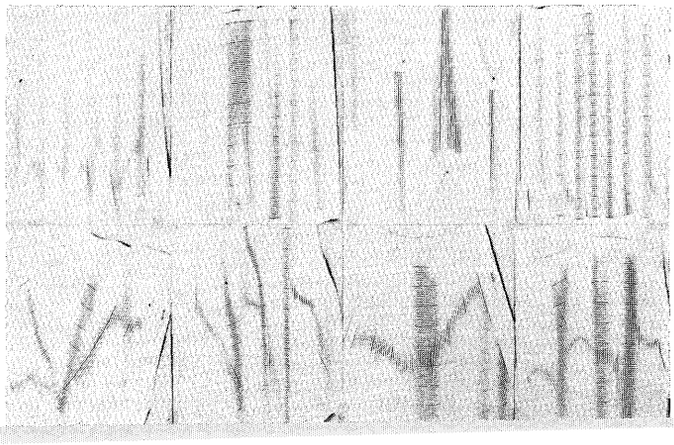


Above: "Ed Ruscha in transition." Zerox by Don Neal.

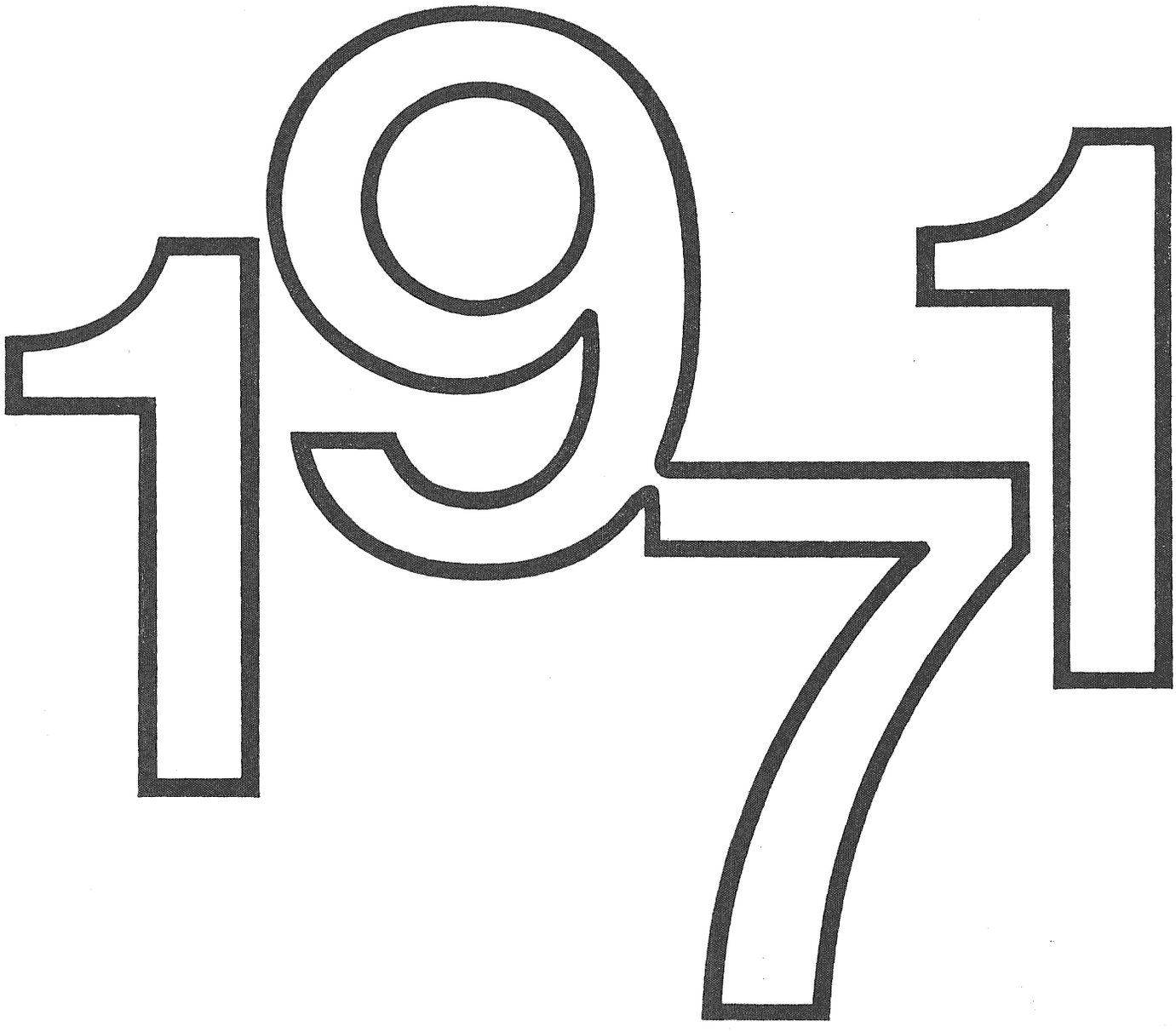


Above: "Tina." Photograph created by the use of television, Zerox, Thermo-fax and regular photographic processes. The photograph has been manipulated through 24 stages to its present state. By Don Neal.

Below: "Graph paper sequence No. 1." Below Right: "Graph paper sequence No. 2." Graph paper was manipulated on a Zerox machine, taped together and microfilmed. Presentation is on a silver sensitive paper which is used in industry to reproduce blueprints. By Don Neal.



If you are a senior...



could be the most important year of your life.

As you contemplate one of the most important decisions of your life, you will want to remember this: it is not just "a job" you are seeking—it should be the beginning of a career. And if it is to be successful, both you and your employer must need and want each other.

To help you with your decision, we invite you to consider the opportunities at Pratt & Whitney Aircraft. Currently, our engineers and scientists are exploring the ever-broadening avenues of energy conversion for every environment . . . all opening up new avenues of exploration in every field of aerospace, marine and industrial power application. The technical staff working on these programs, backed by Management's determination to provide the best and most advanced facilities and scientific apparatus, has already given the Company a firm foothold in the current land, sea, air and space programs so vital to our country's future.

We select our engineers and scientists carefully. Motivate them well. Give them the equipment and facilities only a leader can provide. Offer them company-paid, graduate-education opportunities. Encourage them to push into fields that have not been explored before. Keep them reaching for a little bit more responsibility than they can manage. Reward them well when they *do* manage it.

Your degree can be a B.S., M.S., or Ph.D. in: MECHANICAL ENGINEERING • AERONAUTICAL ENGINEERING • ENGINEERING SCIENCE • ENGINEERING MECHANICS.

If your degree is in another field, consult your college placement officer—or write Mr. Len Black. Engineering Department, Pratt & Whitney Aircraft, East Hartford, Connecticut 06108.

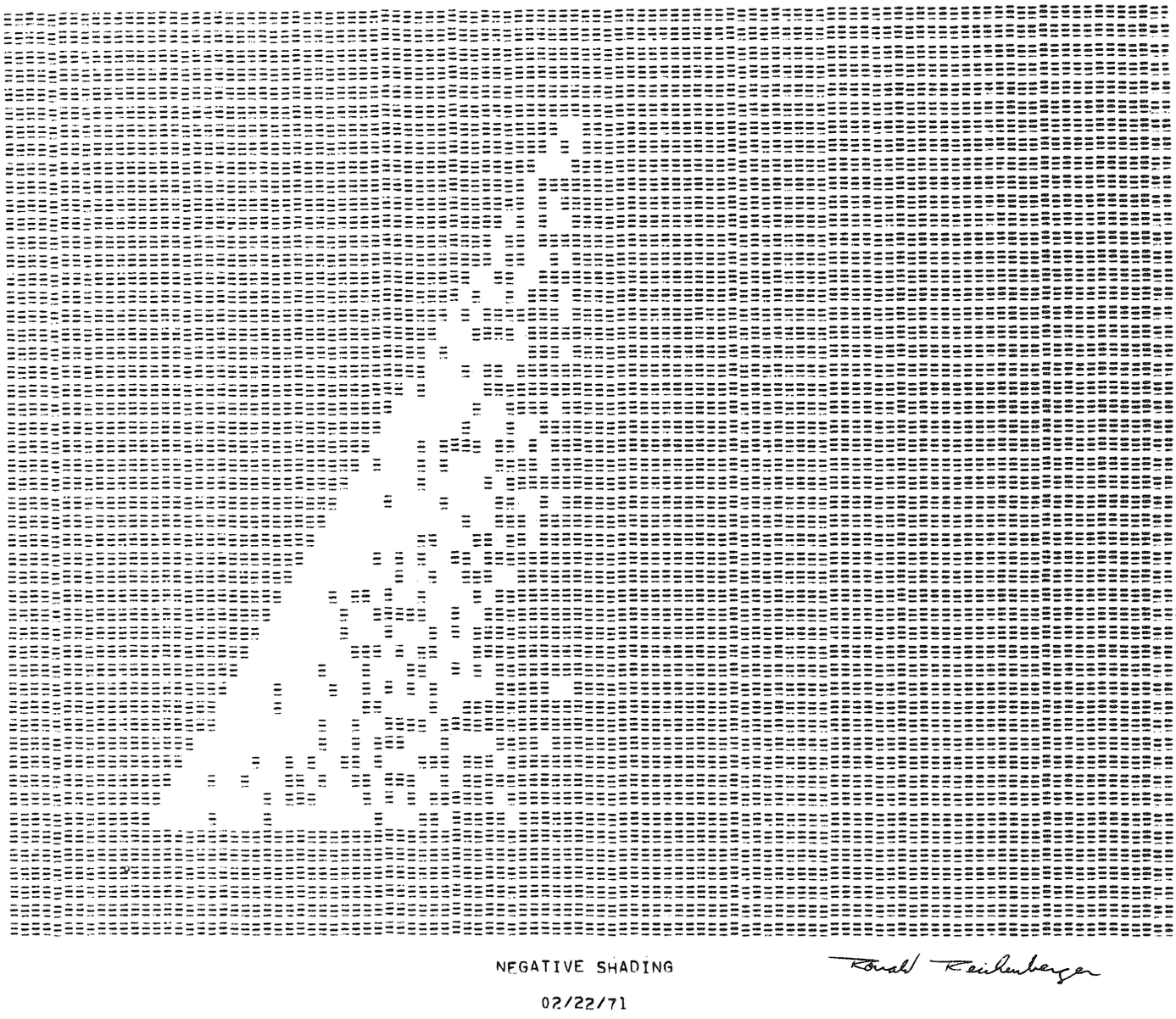
Pratt & Whitney Aircraft

EAST HARTFORD AND MIDDLETOWN, CONNECTICUT

U A

DIVISION OF UNITED AIRCRAFT CORPORATION

An Equal Opportunity Employer



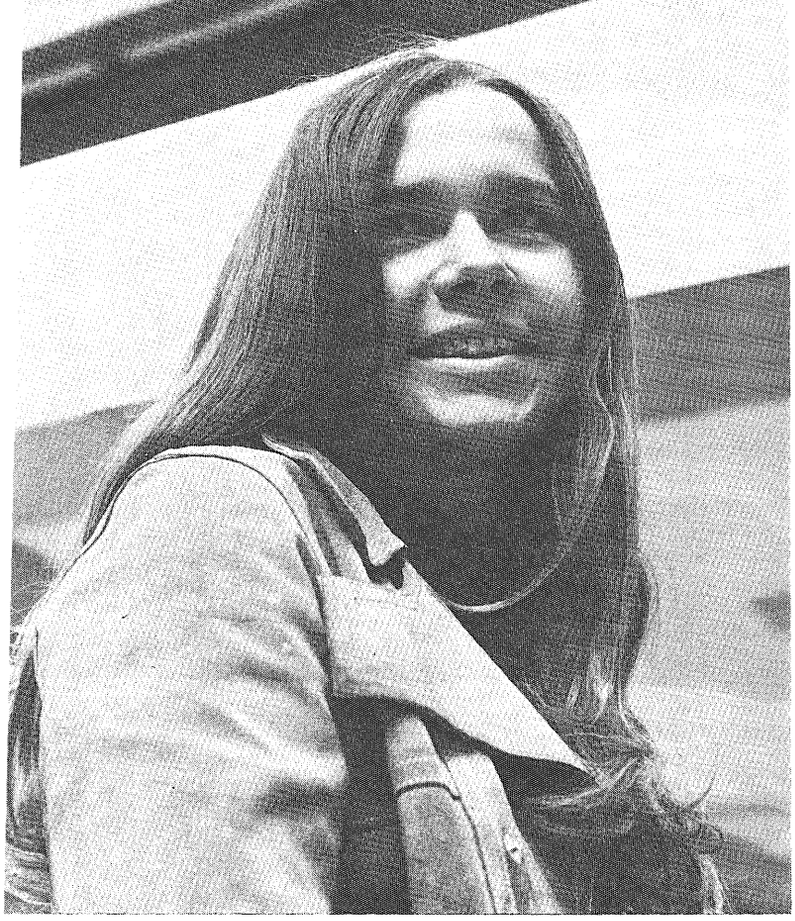
Above: "Negative Shading," computer printout from a new program called Art 2, developed by Ronald Reichenberger. See article for explanation.

Continued from page 10

consisting of still or moving papers and computer-driven ink pens controlled in a variety of ways; and graphics created on the cathode ray tubes with an electron beam exactly like a TV image. This image is photographed in various stages with a camera, and an electronic console is used to control the picture and advance the film. Static graphics are made by enlarging film stills.

In certain art forms the computer is definitely superior to man, most obviously in its capacity to produce virtual redundancy, absolute randomness, and its super high speed. A computerized drawing machine can produce a work with redundancy beyond the breaking point of the most patient and painstaking draftsman, endlessly repeating precisely identical patterns, even merely placing one line exactly on top of another. Designs characterized by smooth curves, evenly spaced lines, moiré patterns, and symmetry are qualities difficult to obtain by other media. Yet, are characteristic of many natural phenomena and human experience. On the other hand, computers can be programmed to form random structures and aleatory improvisations beyond one's wildest dreams because they are machines subject to no limitations other than those with which they are programmed. Every program, of course, combines varying proportions of structure and chance. The computer's speed factor has advantages that are obvious in such areas as film animation, but are equally important in creating still graphics. It is possible to program the computer to produce patterns based on any specific premise, defined by a set of parameters and leave the various possibilities within them to chance. In this way, certain

Continued on page 23

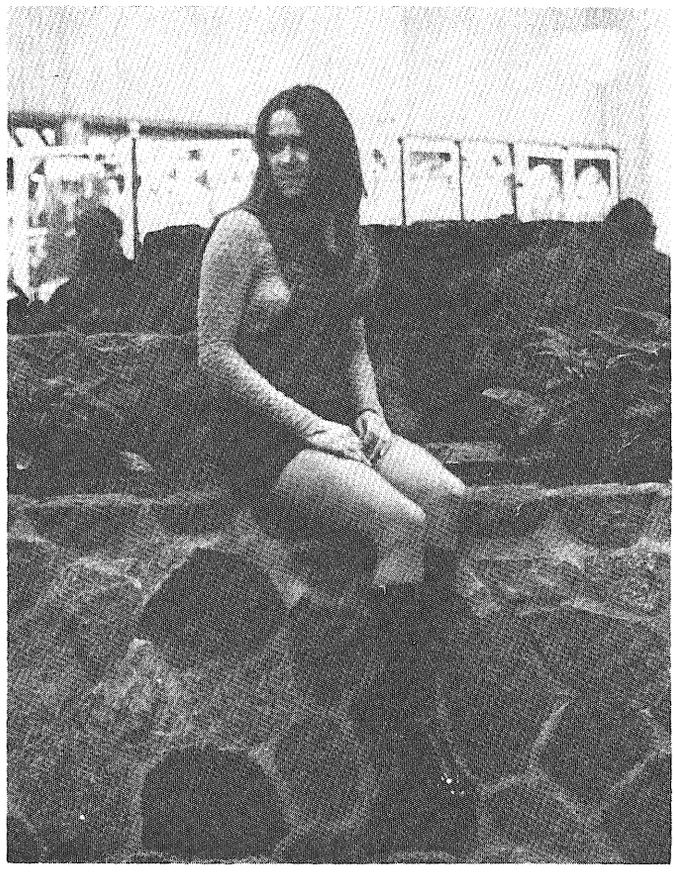


Miss

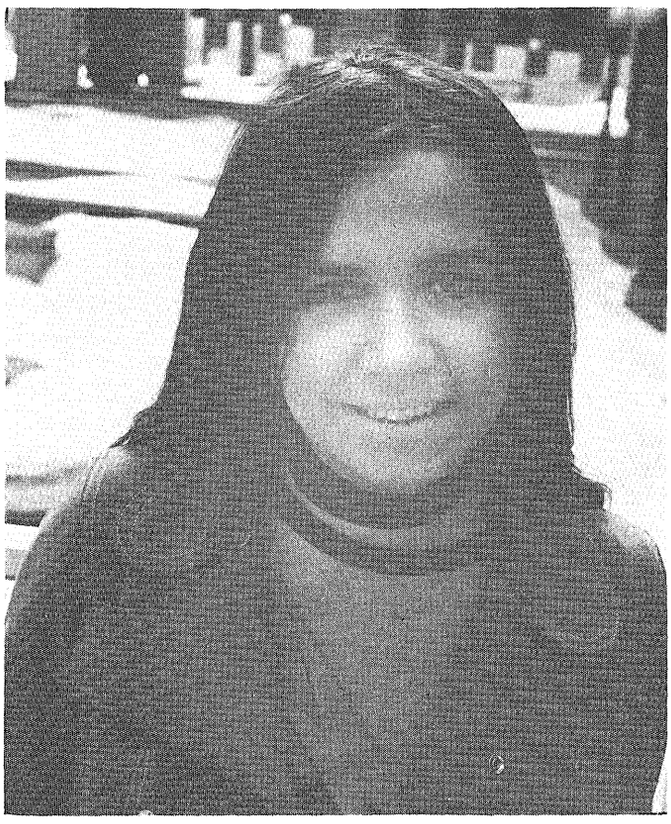
March

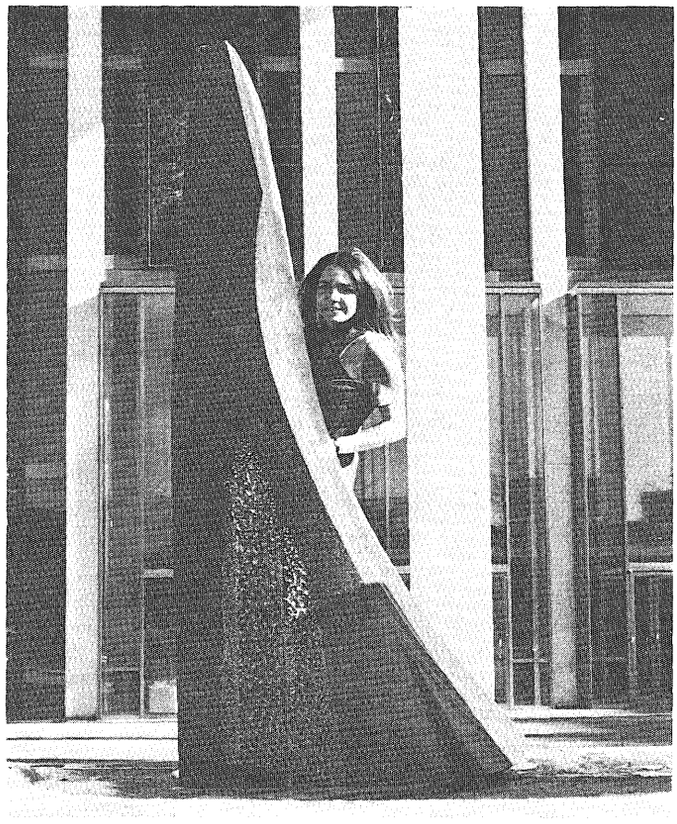
Mary

Nelson



A few weeks ago, one of our staff members brought Mary down to ME 2 to meet the gang. Needless to say she was an instant hit. We tried to persuade Mary to join our staff and grace our office with her charm, but with a major in textiles, clothing, and business; brown-haired, green-eyed, Mary has little time to spend away from her studies. What spare time she does have is taken up by swimming or sewing. Although Mary couldn't join our staff roll, we're glad she took time out to be our lovely Miss March.





Dr. Leete and some of his specimens.

Introducing Biosynthesis at Minnesota

by William Loye

We have always depended upon the plant world to give us food, but we have also used plants for making medicines, dyes, poisons and perfumes. Recently, studies, such as those by Dr. Leete, were initiated to discover why plants can create these materials. If we can find out how to make the medicine such as atropine, reserpine, or morphine, we can find more about how they affect man, and how to synthesize them. There are three questions that chemists must first answer: What are these compounds? Why do plants create the compounds? How are they created?

The first question is easy to answer. These compounds are known as alkaloids. An alkaloid is an organic compound which contains nitrogen usually located in a heterocyclic ring.

The second question is yet unanswered, but not unexplored. We can't be sure as to why these alkaloids are formed. It may be for germination purposes, or it may be for protection, but scientists do not know for sure.

How do plants create alkaloids? Well, to answer this question, Dr. Leeke started investigations by growing the plants in an environment containing Carbon-14. Carbon-14 is a radioactive isotope whose half-life is known and works as a tracer. The Carbon-14 may also be injected into the precursor (forerunner to the alkaloid). The Carbon-14 was then traced and the molecules containing the isotope are investigated, as the structure may undergo numerous changes before finally settling down as an alkaloid. All these changes must be understood before chemists can attempt to make these compounds themselves.

Some of the more common medicinal alkaloids which are obtained mainly or solely from plants are: Codeine, from opium poppies, used as a sedative. Quinine, from Cinchona bark, used in treating malaria. Morphine, from

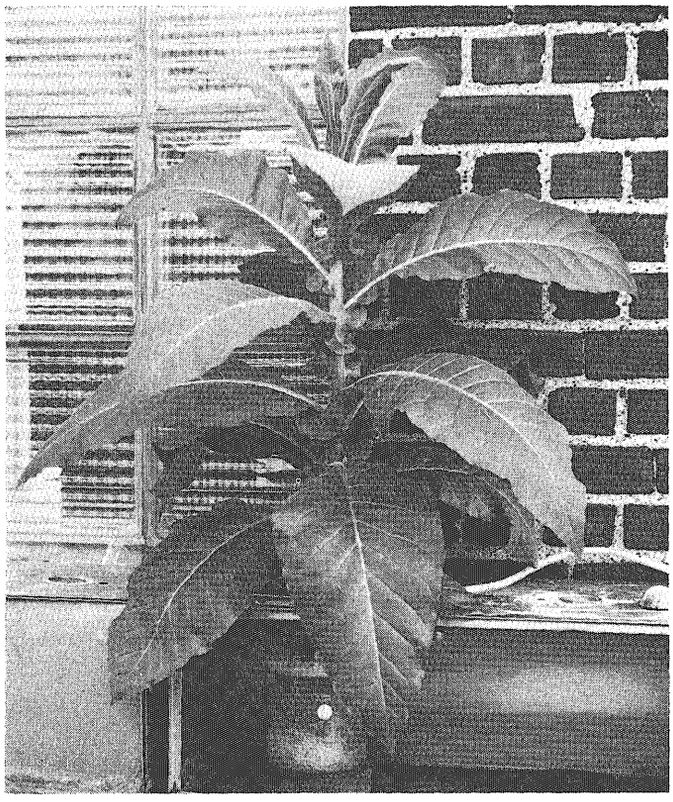
the papaver somniferum, used as a pain remover. Atropine, from datura stramonium, used in treating eye disease (inactivates optic nerves). Reserpine, from the rauwolfia sepentina, used as a tranquilizer. Vinblastine, from the vinca rosen, used in treating cancer and Hodgkin's disease.

Some other common alkaloids are nicotine, from the tobacco plant, and cafeine from the coffee bean. The poisons, strychnine and coniine from the strychnos species and hemlock, respectively, and finally, mescaline, a hallucinogen from the anahalonium lewinii.

If scientists can find out how and why plants make alkaloids, they can pave a way to a better understanding of how alkaloids affect us and how they can be synthesized.

Above: Here Dr. Leete shows a few of the hundreds of plants used by him in his studies.

Below: This plant has been grown in a Carbon-14 atmosphere. It will help tell why plants produce alkaloids.



About Dr. Leete . . .

Dr. Edward Leete came to the United States after working in Canada for four years on a fellowship grant. In 1958, he came to the University of Minnesota and is now a Professor of Organic Chemistry.

Dr. Leete started his career as a dyes chemist and soon became interested in biosynthesis. Dr. Leete, sponsored by the National Institute of Health has done much research with alkaloids.

Dr. Leete's majority of research has been done on hemlock and its alkaloid coniine. Hemlock was the same poison that killed Socrates.

What's New

...in Science and Engineering

Xeritron Sensors

A new moisture transducer is said to be capable of accurate and continuous measurement of relative humidity throughout the complete 0-100% RH range, independent of temperature and pressure.

The 5/16" × 2½", nonpolarizing Xeritron sensor is extremely rugged, ideal for use within hostile environments, and is unaffected by oil, dust, dirt, solvents, weaks acids and bases. It can be washed and rinsed in hot water or cleaned in sonic cleanser without loss of calbration.

Operating principle is based on an inert cellulose crystallite actuating a thermally compensated, solid state resistive element in a half-brdge configuration. Response is said to be immediate, with 63% of step change reached within three minutes.

Specifications include ±2% f.s. accuracy; a repeatability of ±½% f.s.d.; 0 hysteresis; and a resolution of 0.25%. Operating temperature range is –40° to 125° C; operating pressure, ambient. Maximum sensor current is 2 ma, DC or AC, with resistance a nominal 2000 ohms.

Because of their high output, Xeritron sensors are compatible with all standard recorders, directly or by means of signal conditioner boards and multiple channel interfaces.

Electronic Calculation

A compact, lightweight electronic calculator that simplifies virtually all commonly encountered engineering problems, has been announced.

The new calculator, weighing only 12 pounds, is about the size of an office typewriter. The calculator employs Large Scale Integrated circuitry throughout. By means of a simple key depression, the calculator provides logarithm, trigonometric functions, logarithm, raises any number to any power, square root, factorials and other complex algebraic calculations in milliseconds. Reference tables for logs and trigonometric functions are necessary.

Keyboard entered data or data recalled from its six memory registers and problem solutions are displayed in a large size illuminated display area. Ten significant digits with sign and decimal point and also a two-digit exponent with sign are shown. Six data storage registers eliminate the necessity to jot down preliminary answers required later in a complex calculation.

The new calculator performs a virtually limitless variety of mathematical functions by means of single key depressions. In its Large Scale Integrated circuitry as many as 2,000 transistors function on a single 1/4" chip. This totally new calculator contains the equivalent of 55,000 transistors.

The unit is capable of being upgraded with additional circuitry to increase memory storage registers to 10 and to add a programming capability of up to 128 steps.

Buck Roger's Dream

The early years of America's space program concentrated on the problems of space travel—getting man and equipment into orbit and to the moon and planets. The remaining Apollo moon shots and future space programs, such as the proposed orbiting Space Station, will put this experience to work to learn more about man, his world, and his universe.

The Space Station, scheduled for launch in the late 1970's, will be a full-time scientific laboratory in permanent orbit around the earth. It will house 12 men, on a rotating basis, for periods of up to six months. The Station will make it possible for scientists, with little or no training as astronauts, to perform experiments in a variety of disciplines in the outer space environment.

The Station will allow research in astronomy, physics, biology, medicine, and earth sciences.

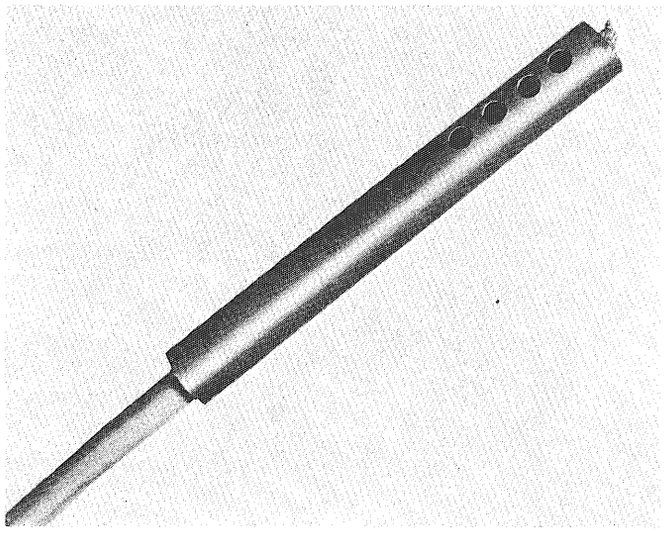
In one concept of the Space Station, laboratories will be of three types: integral laboratories within the Station; attached modules connected to docking ports alongside

the Station; and detached modules capable of operating free of the Station.

Attached laboratory modules will be flown into orbit and attached to the Space Station at docking ports. They will receive logistic support from the Station. They will be used for experiments which need an access to the outside and which require too much equipment to house inside the Station.

Detached modules will dock to the Station for maintenance and other support, but will fly in their own orbit free from the Station during experimentation. They will be made up of a laboratory section and a common support section to provide power, data handling and other logistic support. Detached modules are necessary for experiments which have precise positioning requirements or which would be affected by contaminants from the Station such as atmosphere leakage and reaction jet exhaust.

Propellant Testing



Is it feasible, from a heating and structural point of view, to attach four 120-inch solid-propellant strap-ons to the Saturn V rocket, thus boosting its thrust from 7.5 million pounds to 13 million?

To find out for NASA, Cornell Aeronautical Laboratory built a model of the Cape Kennedy launch tower and fired 1/45th-scale models of the rockets. Lift-off trajectory was simulated by fixing the model booster at a series of test stations along the tower and firing the motors for 1/25th of a second.

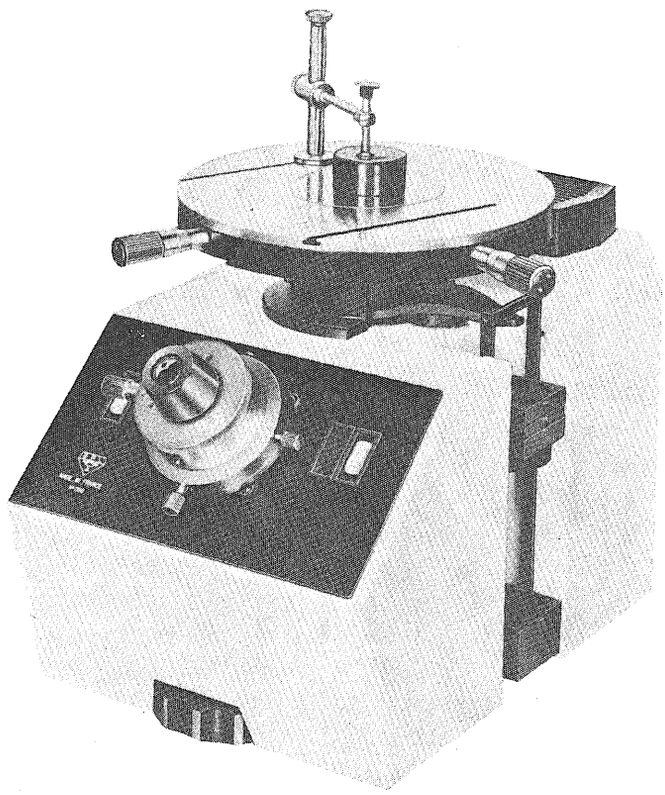
To simulate the LOX and RP-1 propellants normally used in the Saturn, gaseous oxygen and gaseous ethylene were employed. The strap-on model rockets burned thin strips of the same propellant that is in the Titan-IIIC's 120-inch solid motors. The resultant data was turned over to NASA for analysis of the firings' effect on the launch tower and rocket.

Heat transfer and pressure data from the 1/25th second firings compared favorably with that from long-duration tests conducted with similar models by NASA's Marshall Space Flight Center.

Hardness Tester

A new Micro Hardness Tester featuring automatic cycling has been developed. The general arrangement of this instrument is similar to that of an inverted metallographic microscope. The diamond penetration rate, the duration of time when pressure is applied, and the return to the initial position are automatically programmed. The only function the operator has to perform is to push a button to start the cycling. A pilot light shows the beginning and the end of the operation.

The sample is placed on the circular rotatable stage measuring 200 mm in diameter. Metal inserts enable accommodation of specimens of various dimensions. The center of a catoptric type 50× objective is fitted with a pyramid-shaped Vickers or Knoop objective. Indentation is accomplished by moving the complete objective. An appropriate selection of weights ranging from 3 to 2000 grams is placed on the scale. Upon completion of the



cycle, the diagonal length of the indentation is measured by reading the graduations of the micrometer eyepiece. Each division corresponds to one micron, the maximum measurable length is 300 microns. Tests are conducted at magnifications of 500×. The instrument is extremely accurate in placing indentation, vibration-free, and simple to operate.

Gobble Gobble!

Art, Cont. from page 14

limitations are provided within which the computer can improvise and in the space of several seconds race through the entire visual potential inherent in the particular scheme.

ART 1

ART 1 is a computer program in which the computer has within its memory bank an art language upon which the artist can utilize to make a work of art. It was developed at the Department of Electrical Engineering and Computer Science at the University of New Mexico by Richard H. Williams and Katherine Nash.

ART 1, in all its detail, is somewhat involved. It contains approximately 350 separate statements written in Fortran IV. An artist, however, does not need to concern himself with programming complexities since the entire program is stored in the computer's memory bank. The artists need only relate his ideas, by means of a simple code, to the computer in machine language. The ART 1 program will cause the computer to print out designs in a rectangular format, or array. Within the array any combination of lines, rectangles, triangles, ellipses, and exponential functions may be arranged in positive or negative space. The exact arrangement is accomplished by using coded data cards. Overprinting of a second array can be used to increase the density range of the design. Alterations to the basic program provide for shading in an additional two arrays which further increases the visual impact of the designs. Examples of this effect are included with the article.

Many of the computer graphics are by "non-artists," people who would never have put a brush to canvas. New media or new systems, inevitably alter the shape of art. New possibilities extend the range of expression of those creative people whom we identify as painters, film-makers, composers, and poets. It is very rare that new media or new systems should bring in their wake new people to become involved in creative activity. These new people have started making images, both still and animated, which approximate and often look identical to what we call "art," and display in galleries. ◻

Splinters

—vilitas et crudas semper eternam

by Barry Johansen and Ralph Polkinghorne

There was a forester who was milking a cow at the top of a five hundred foot cliff. He slipped and would have been killed if he didn't have something to hang on to. He lived to tell about it, but the neighbors thought it was an air raid.

• • •

Adam didn't have a funny bone, but he did have a lot of fun with a spare rib.

• • •

Some think that I'm tiring of a bachelors life, but what's good enough for my father is good enough for me.

• • •

"I never wear gloves on a date, I feel better without them."

• • •

"Do you smoke after making love?"
"I dunno, never bothered to look."

• • •

And now a cheer for the engineers who build bridges and the coeds who come across.

• • •

The following comment was found written across our editor's last English theme: "Your style is low, but it's the perfect medium for your ideas."

• • •

"Are you afraid of the big bad wolf?" asked the EE.
"No", replied the coed.
"That's funny, the other two pigs were."

• • •

Groom: "So you didn't know I wore elevator shoes and a toupee."
Bride: "And I've got a couple of surprises for you, too!

• • •

And then there was the farmer's daughter who was sent home from the county fair 'cuz she couldn't keep her calves together.

• • •

"Am I the first woman you ever made love to?" cooed the coed.
"You might be," he replied, "your face seems familiar."

• • •

A kiss is a mouthful of nothing that tastes divine, and sounds like a cow pulling her foot out of the mud.

After a fire in one of the co-ed dorms, some of the tenants were forced to bunk in a gym. Seeing that a temporary wall couldn't be constructed, the dean of women painted a white line down the center of the floor. She then turned to the students to explain.
"The men are to stay to the right of the line and the women to the left. If anyone crosses the line, it will cost him or her a five dollar fine. The second offense will cost ten dollars, the third, twenty dollars. Are there any questions?"
"Just one," an EE responded. "How much for a season pass?"

• • •

The born loser is the guy who gets lockjaw and seasick at the same time.

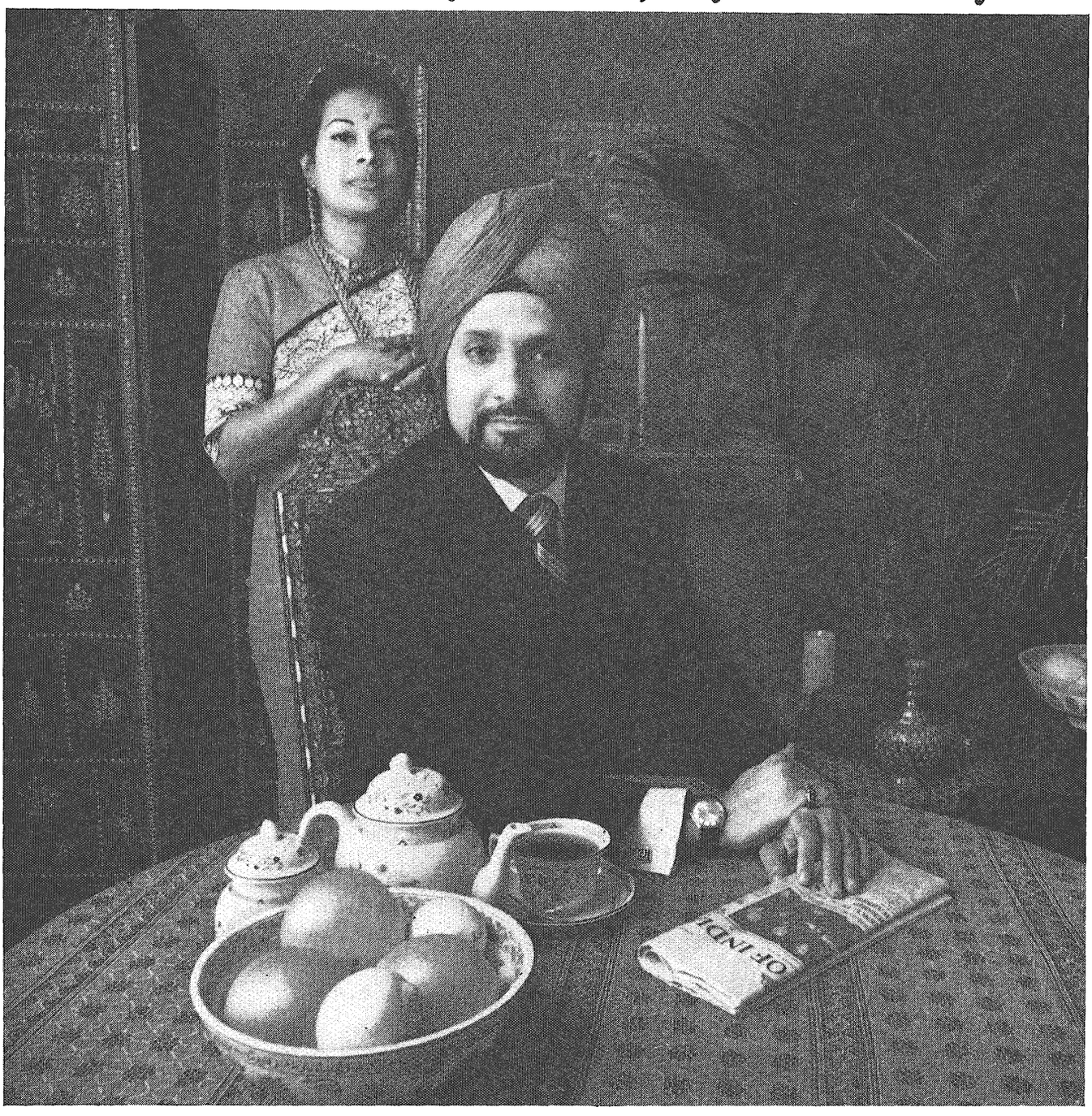
• • •

What is a zebra?
Twenty-five sizes bigger than an A-bra.

• • •

Have you ever heard about Bruno the brown nosed reindeer? He's second in line behind Rudolph. He's just as fast but can't stop as fast.

When they look at us, they see a little of you.



When Union Carbide sends its people to Asia, Africa, South America and even Europe, they represent a country as well as a company.

So while we're out to make money abroad, we're also out to make friends abroad.

Sometimes, it's as simple as knowing local customs.

In Singapore, our Eveready battery plant has a cafeteria that serves three different menus. To meet the dietary, ethnic and religious needs of our Indian, Chinese and Malaysian employees.

Othertimes, making friends and making money is a little more complex.

To mine huge manganese deposits in Ghana, we built a whole town. From the ground up. Later, we put a plastics plant in Ghana. And then a battery plant. And made even more friends.

None of this is our newest idea. It's something Union Carbide discovered long before international business was fashionable.

And it's all quite simple.

Overseas, we're you.

UNION CARBIDE THE DISCOVERY COMPANY

For additional information on our activities, write to Union Carbide Corporation, 270 Park Avenue, New York, New York 10017. An equal opportunity employer.

An engineer can cut crime as well as any cop.

Maybe better.

Last year, murder was up 7%. Rape was up 17%. Robbery was up 14%.

It's getting to the point where a woman can't show her face on a dark street. And grown men are running scared. Sadly, crime has become a part of our everyday lives.

Where do we turn for help? To police, of course. But why not also to engineers?

Engineers at General Electric set out to develop a more efficient streetlight. And they came up with one of the most efficient crime fighters ever invented.

It's called the Lucalox® lamp. It puts twice as much light on a street as any other lamp without any extra operating cost. And wherever Lucalox has gone up, crime has gone down. By 50% or more in city after city.

But that's not all an engineer can do. He might design communications equipment that enables one patrolman to do the job of two. Or a complex of traffic monitors that puts twenty cops back on the beat. Or even a patrol car to do its special jobs in a better way.

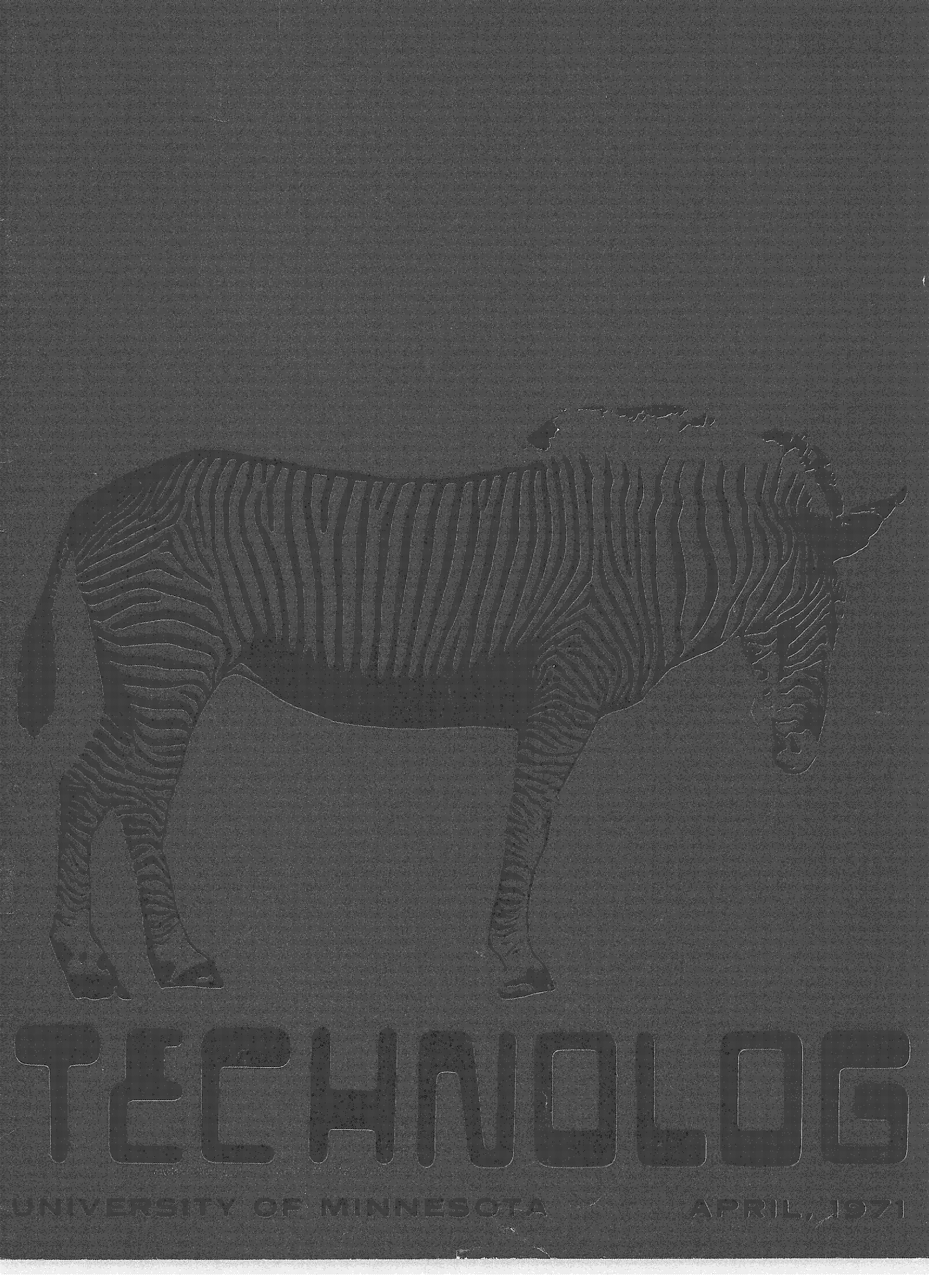
It's sometimes hard for people to realize that engineers, with their technology, can solve social problems. But, in fact, some social problems can't be solved any other way.

So if you're an engineer who's bothered by social problems, you're in a unique position to help.

General Electric could use your help. We see more problems around us than we know how to solve. So what we need is more engineers.

GENERAL ELECTRIC

An equal opportunity employer

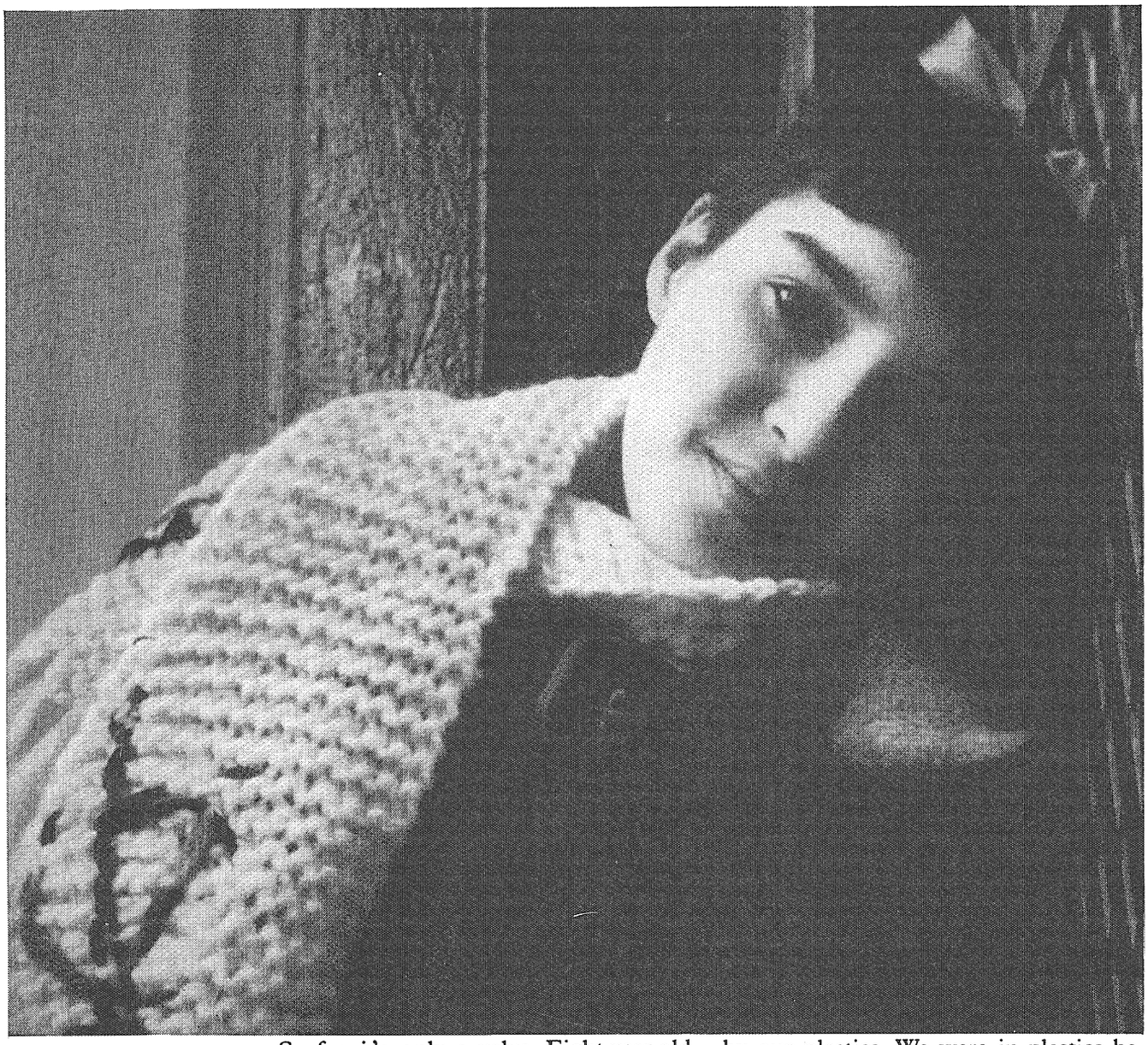


TECHNOLOG

UNIVERSITY OF MINNESOTA

APRIL, 1971

Beneath this soft and warm exterior, there lies a heart of plastic.



So far, it's only a valve. Eight-year-old Janet Hernandez has one.

It may not be long before a whole working heart will be made out of plastic.

Men in plastics research at Union Carbide are working on the almost impossible job of designing plastics compatible with the body.

Their most crucial job is making an ultra-thin polypropylene fabric for lining the inside of the heart. A fabric coated with parylene that will allow human tissue to grow into and around it to keep blood from clotting.

A plastic heart isn't the only part of the body we're working on. Maybe someday there will be a little plastic in all of us.

Right now, we've got you surrounded by our plastics. We were in plastics before most people knew the word. We make more plastics than anyone else. We haven't scratched the surface yet.

Why is a great big company like Union Carbide so concerned about a little bit of plastic for the body?

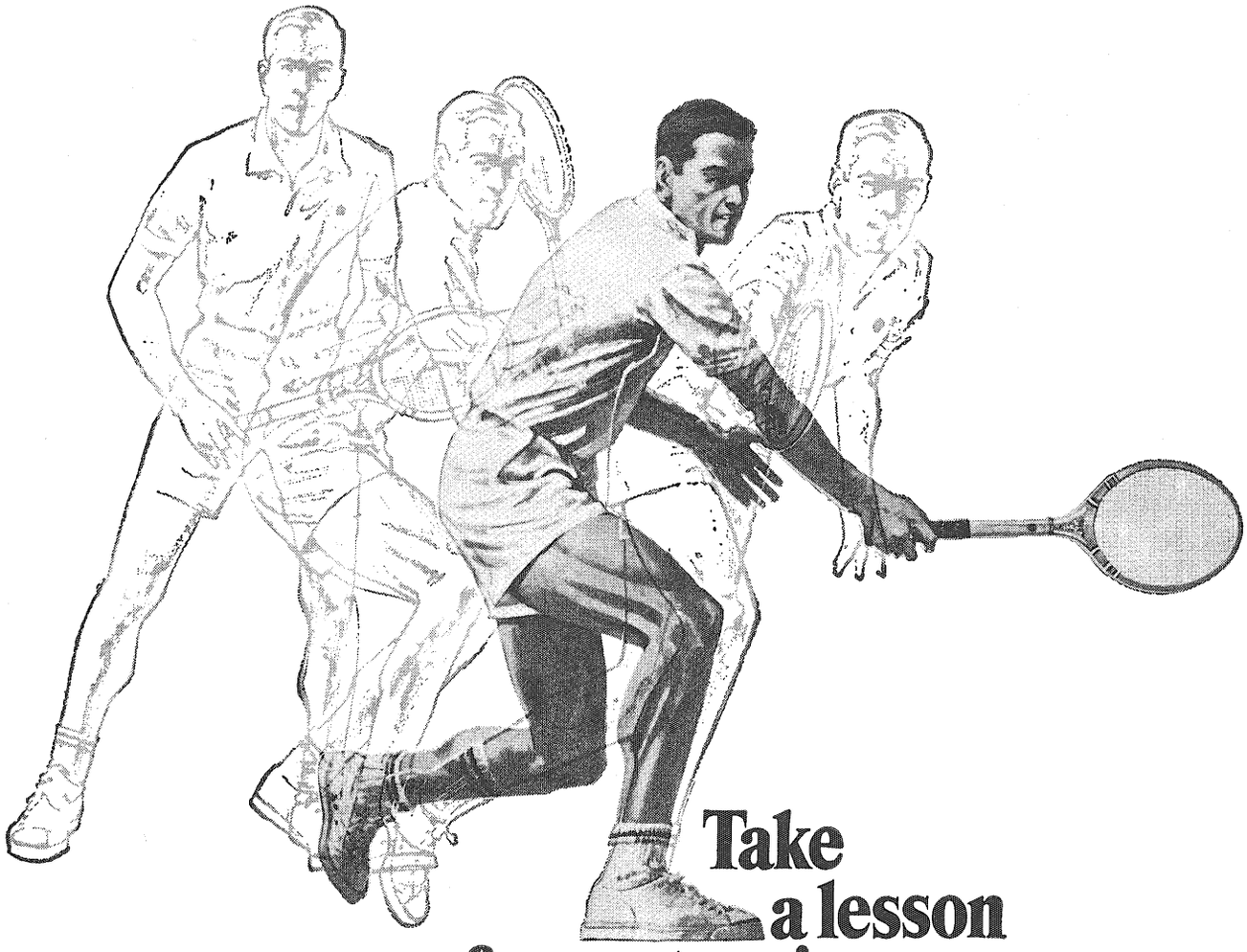
Because.

Beneath our corporate exterior, there beats a heart.

UNION CARBIDE

THE DISCOVERY COMPANY

For additional information on our activities, write to Union Carbide Corporation, 270 Park Avenue, New York, New York 10017. An equal opportunity employer.



Take a lesson from a tennis pro.

A tennis champion's powerful backhand looks as smooth and unhurried as a ballerina's graceful bow. How's he do it? By being in the right position in plenty of time.

"Remember this about the backhand," the pros advise. "Get both feet around pointing toward the sideline. And always make sure the right foot's forward, so your body doesn't cramp your swing."

Getting into proper position early is good advise for college seniors, too. Here's the first step:

When companies interview on your campus, make sure they interview you. When The Timken Company representative stops by, don't let him go without seeing you.

He'll fill you in on our work (maybe your work) with the aerospace, automotive, construction, chemical industries. Our openings in production, engineering, sales, marketing, finance, metallurgy. Our $221 million expansion and modernization program. And our strict policy of promotion from within.

So you won't get caught flat-footed when it's your turn to make your move. The Timken Company, Canton, Ohio 44706.

Timken® bearings are sold around the world. Manufacturing in Australia, Brazil, Canada, England, France, South Africa and the U.S.A.

An Equal Opportunity Employer (m/f).

TIMKEN®

REGISTERED TRADEMARK

THE TIMKEN COMPANY MANUFACTURES TAPERED ROLLER BEARINGS, FINE ALLOY STEEL AND REMOVABLE ROCK BITS.

You don't have to sacrifice critical properties for workability

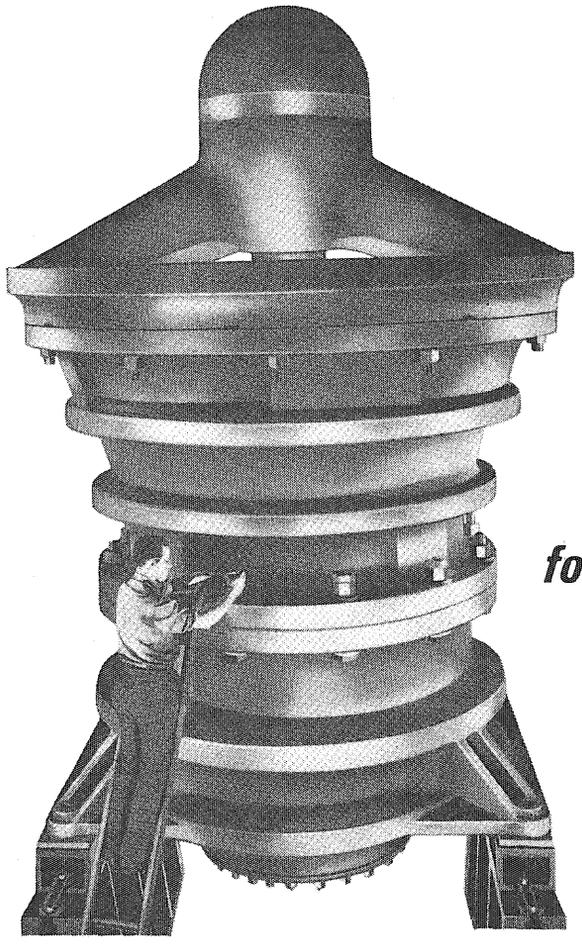
With *cast-steel* you don't have to sacrifice critical properties like abrasion resistance just to get machinability or formability . . . *Any* steel composition can be cast directly to shape.

In this gyratory crusher, standing up to rough taconite and hematite ores meant using a difficult-to-work high carbon steel. Casting the critical spider arms not only eliminated machining and forming problems, but made an exceptionally rigid hollow box design economically feasible. . . . Seven other major components were also made of *cast-steel*—each composition selected for a specific job without compromise for working characteristics.

You can specify *cast-steel* components in compositions which are difficult or even impossible to machine, forge or weld. Whether you need hardness, toughness, resistance to heat and corrosion, or what-have-you, *cast-steel* frees you to choose the best composition and shape for design requirements.

Want to know more about *cast-steel?* We're offering individual students free subscriptions to our quarterly publication "CASTEEL" . . . Clubs and other groups can obtain our sound film "Engineering Flexibility." Write Steel Founders' Society of America, Westview Towers, 21010 Center Ridge Road, Rocky River, Ohio 44116.

STEEL FOUNDERS' SOCIETY OF AMERICA



Cast-Steel for Engineering Flexibility

TECHNOLOG

VOL. 51, NO. 7 | Official Student Publication of the Institute of Technology, University of Minnesota | APRIL, 1971

FEATURES

DEPARTMENTS

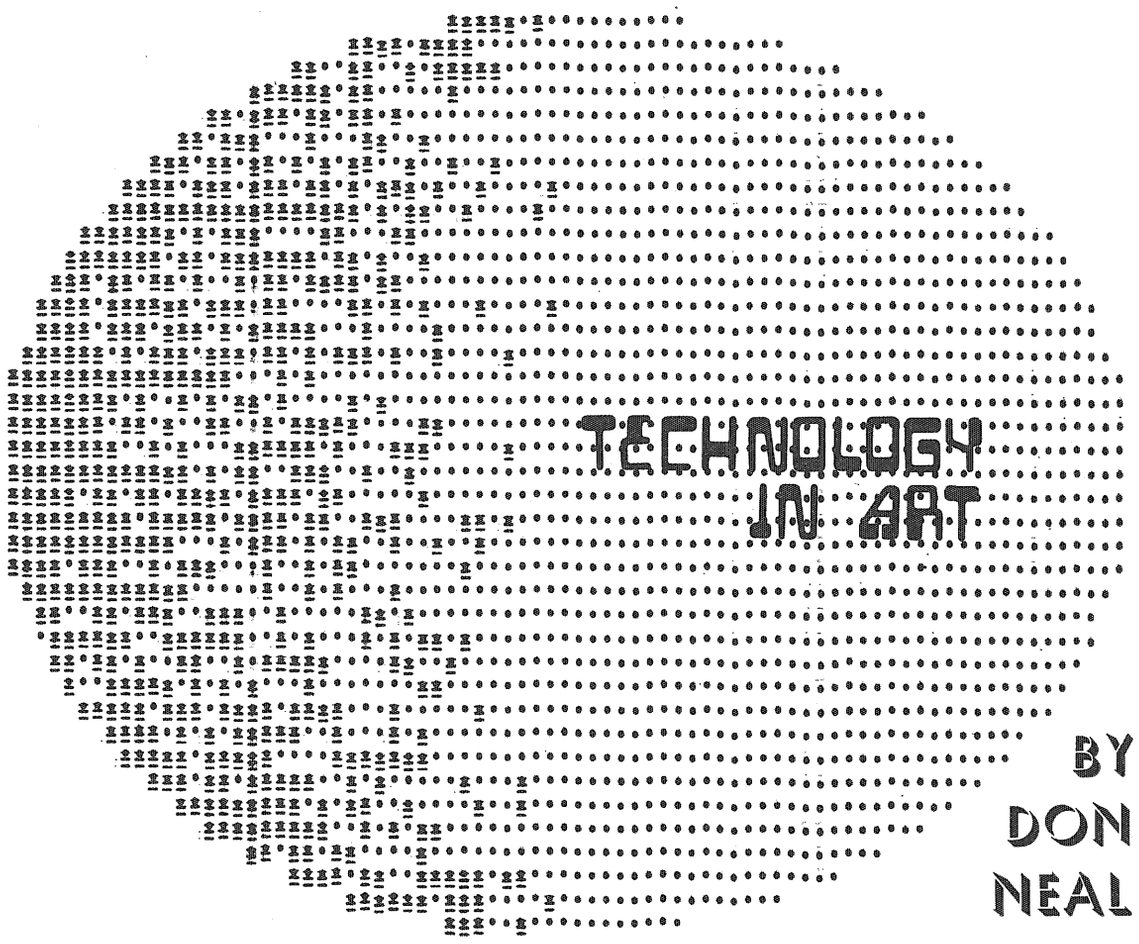
THIS MONTH'S COVER

A two color abstraction

by Allen E. Antilla of
Infinite Graphics Inc.

MEMBER OF ECMA

Published monthly, October through May. Second-class postage paid at Minneapolis, Minnesota. Office: Room 2, Mechanical Engineering Building, University of Minnesota, Minneapolis, Minnesota 55455. Telephone: 373-3298. Printer: Bruce Publishing Co., 2642 University Avenue, Saint Paul, Minnesota 55114. Publisher's National Representative: Littell-Murray-Barnhill, Inc., 369 Lexington Avenue, New York, New York 10017 and 737 North Michigan Avenue, Chicago, Illinois 60611. Publisher's State and Local Representative: University Engineering Magazine Advertising, F. P. McGrath Manager, Box 14026 University Station, Minneapolis, Minnesota. Telephone 612-225-0708. Member of the Engineering College Magazines Associated, Gordon Smith, Oklahoma State University, Stillwater, Oklahoma. Subscription rate: $4.00 per year, single copies 50 cents. Advertising rates upon request. Any opinions expressed herein are not necessarily those of the Institute of Technology or of the University of Minnesota.



Part II

Man-Machine Interface

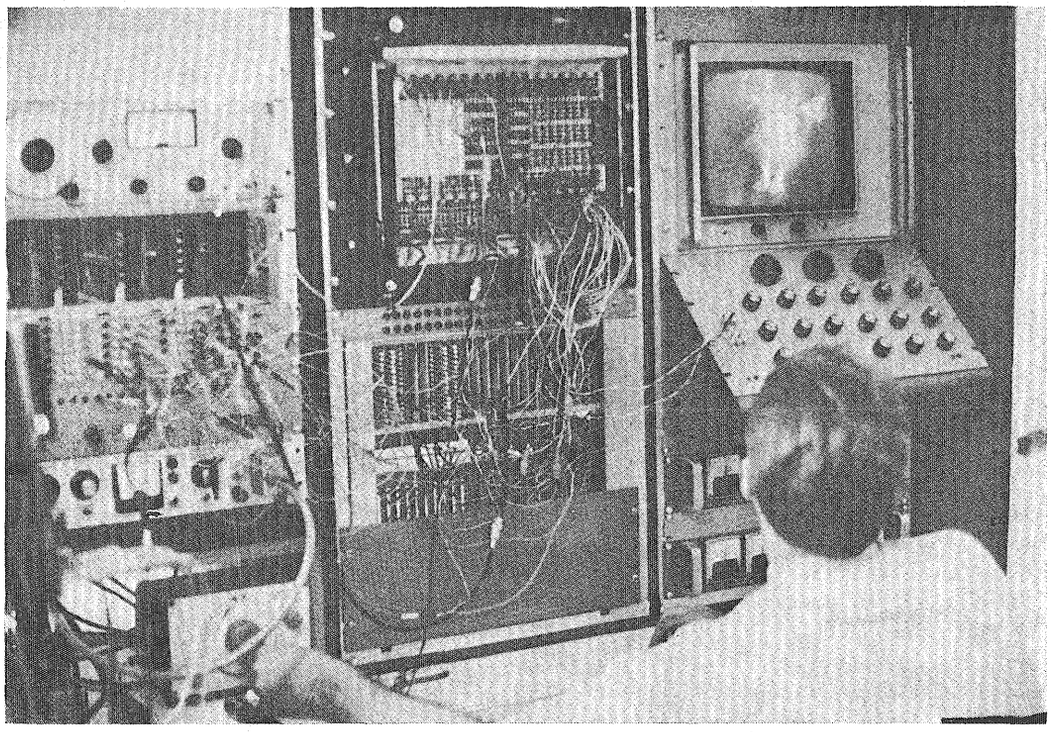
As stated in the first part of this article, the computer with graphic output devices can be used to create and manipulate a wide variety of images which are impossible to be rendered by man. The computer, then, is potentially a powerful tool for artistic expression. There are several problems which hinder the development and acceptance of computer art.

First, what method of control or languages should the artist utilize? In controlling the computers operation anything from almost complete randomness to complete spot by spot control over the output picture is the decision of the programmer-artist. The range of possibilities is so large that it is often difficult to know where to start.

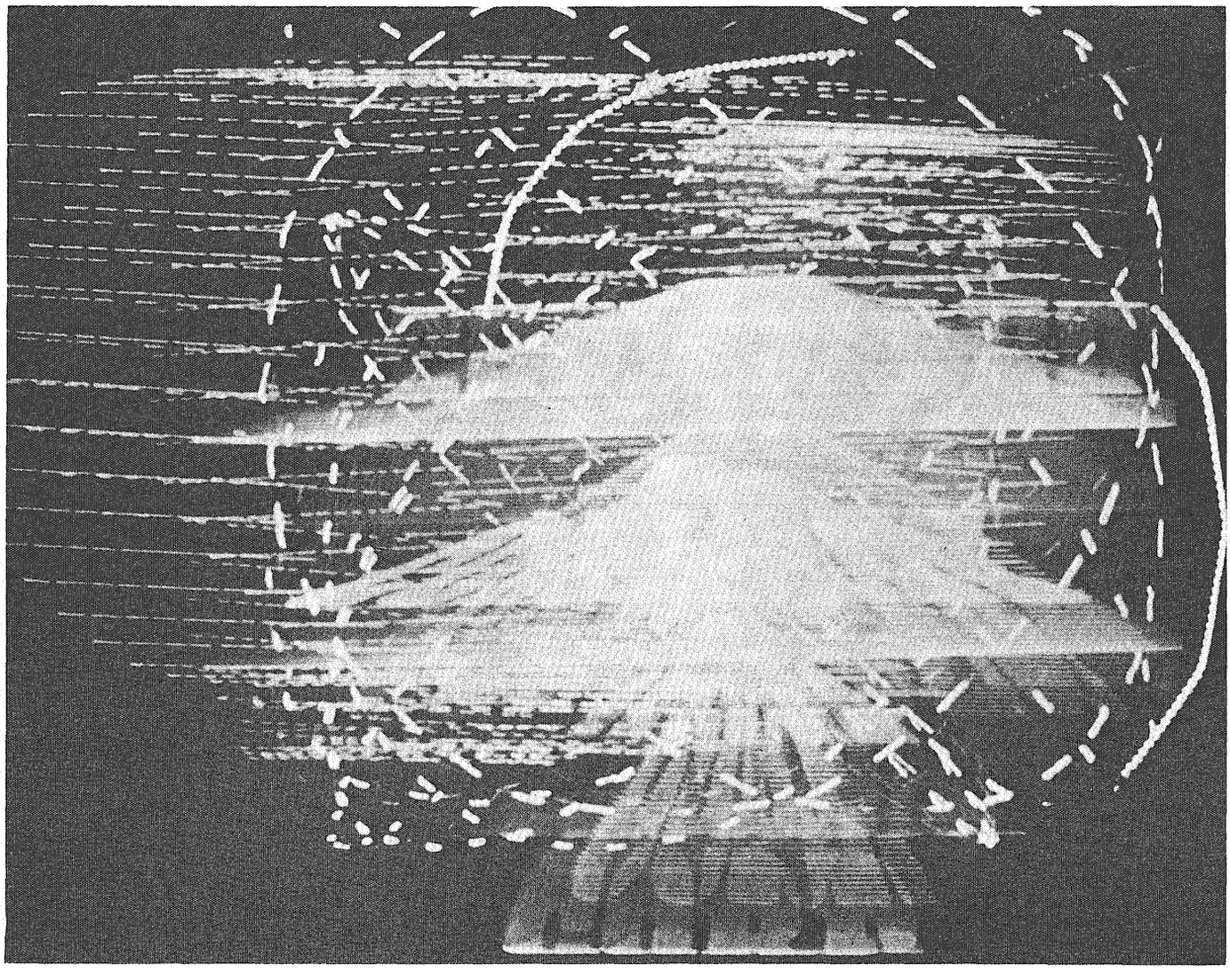
The next problem is deciding who we should expect to be the "artists" in these new media—people traditionally called artists, or computer programmers. These two groups of people are quite different in many respects. Both could be characterized as creative, imaginative, intelligent, energetic, industrious, and competitive. But programmers, in my experience tend to be constricted, painstaking, logical, precise, inhibited, cautious, defensive, methodical, cold and inscrutable in human terms. Their exterior actions are separated from their emotions by several layers of logical defenses, so they can say "why" they did something, without in the least revealing their ultimate motives. Artists, in my experience—and myself included—are free, illogical, intuitive, impulsive, implicit, confused, bewildered, bewildering, experimentive, perceptive, honest, frustrated, sensitive and vulnerable. They do things without being able to say why they do them nor what they are trying to accomplish. Therefore I expect art to come from artists or artists working closely with programmers. Now there is a great need for collaboration between artists and programmers in order to develop meaningful, understandable and useful sets of tools and ways of using them.

Finally, there is, the serious problem of the interpretation of computer art. The machinery which intervenes between artist and viewer blocks a great deal of normal communication. All along the line, the machine shuts out any emotion which may or may not have been intended in preparation. In addition, the medium itself is so new that the viewer is apt to be completely disoriented. He does not know or understand the contortions that either the artist or the machine went through to yield the visible result, nor does he perceive the param-

Continued on page 6



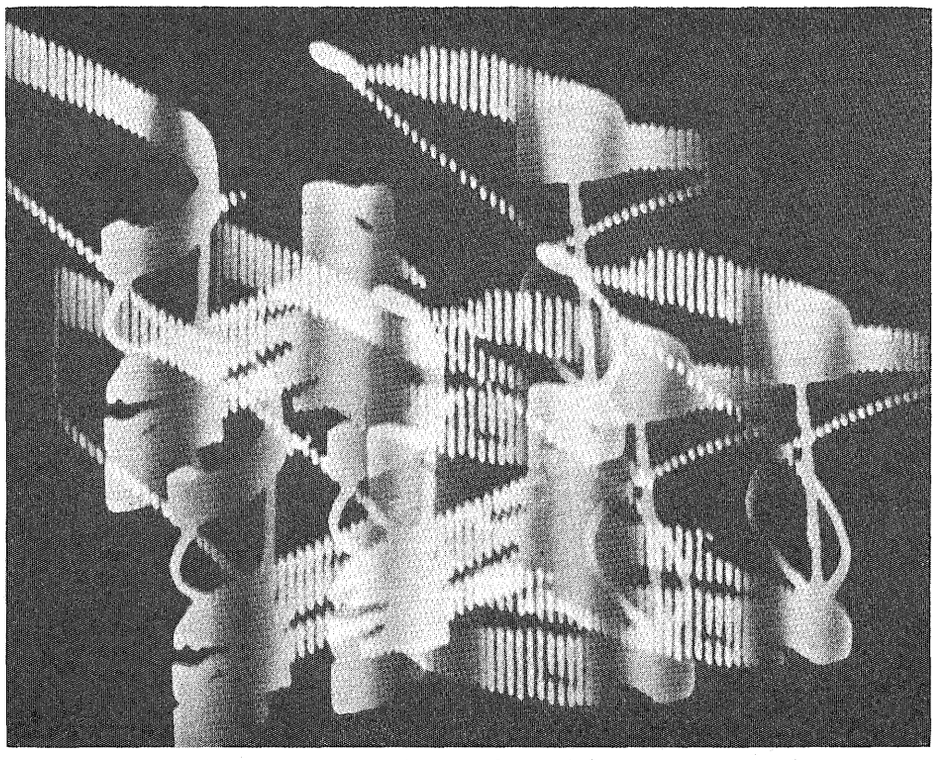
Above: Animation of images is controlled from a computer console.
Below: Animation from computer is filmed in "real" time (at the same time it appears on the screen.)



Continued from page 4

eters of control available to the artist anl the way they are translated into result. He has little feeling for how the result relates to nearby pictures which the artist could have produced but didn't, or what sort of search, if any, the artist made in settling upon and preserving this particular result. This difficulty is linked closely with the philosophy of information theory, which says that a message has little meaning unless the recipient knows something about the total set of possible messages.

These problems offer no short-cut to the very large amount of experimenting which has already begun, but which has barely touched the phenomenal number of things to be tried. The outcome may be a number of relatively stable languages, each for a distinctly recognizable medium of expression. Such a medium will have to become sufficiently established so that the artist can use it to "say something," without the medium itself arousing such curiosity, acclaim, or distain as to severely distract from the artistic content of the work. In other words, the media which make computer art will have to develop a tradition in order to be accepted as art.



Scene from computer animated film by Computer Image Corp.

"Computer Films" by Dr. Kenneth C. Knowlton, Filmmakers Newsletter, Vol. 4, No. 2.

Illustrations courtesy of Computer Image Corporation, Denver, Colorado.

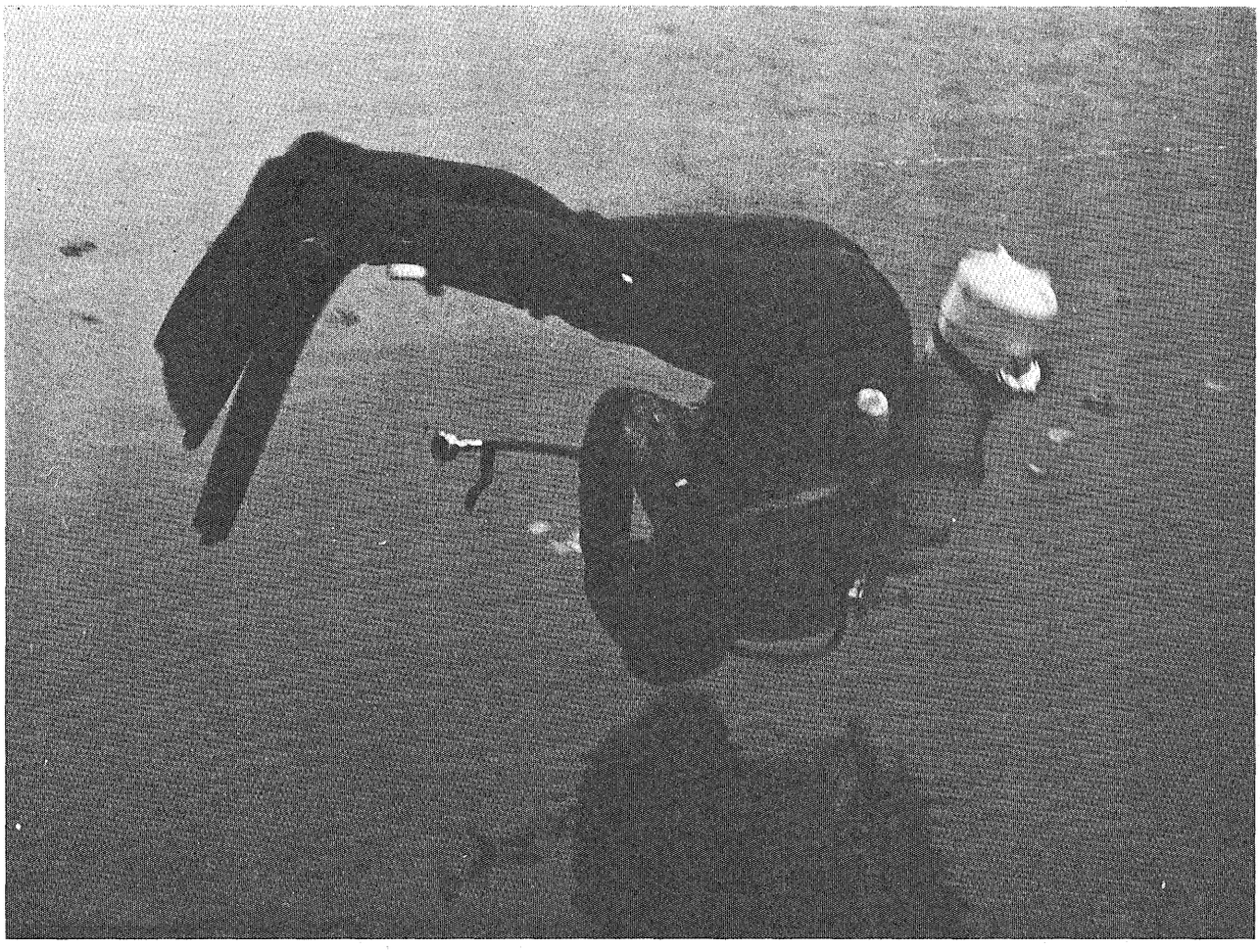


Photo by Becky Phillipps

INTRODUCING . . .

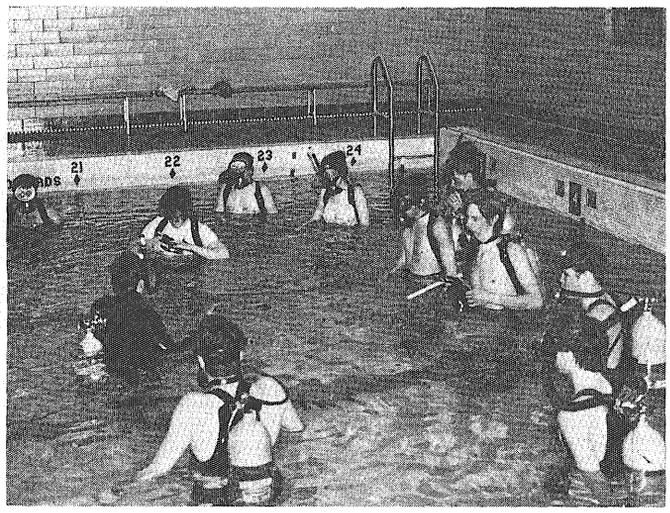
The Aqua-fin-atics

by William Loye

Perhaps you're looking for a chance to get away from it all, to enjoy the quiet, slow-motion, easy life—try scuba! You're curious, and you want to go somewhere that is virtually unexplored—try scuba. Maybe you'd like a little adventure, a chance to pick up some money while doing really interesting work in salvage or photography—try scuba. Or maybe you're in for a wild, different date. They all point the same way—scuba. And if you're adventurous enough, you may be interested.

Twenty-eight years ago a Frenchman named Jacques Yves Cousteau headed underwater with a metal tank of compressed air and started what was to be known as "scuba diving." Before we dive deeper into this subject, let's clear some of the murky water. Skin diving and scuba diving are not the same. Skin diving is going underwater with just a snorkel, flippers, mask, and, of course, a suit. Scuba diving, which is short for "self-contained underwater breathing apparatus," is with the metal tank of compressed air. Although Scuba Diving is fun and exciting, you don't want to rush into it without a little knowledge. There is more to Scuba diving than breathing in and out.

Where do you learn about the *intracacies* of Scuba? From a certified instructor, one like Ralph Swanson who instructs for NAUI, National Association of Underwater Instructors. He will start you out in a course with basics like swimming 300 yards, treading water for at least 5 minutes, treading water with legs only, swimming underwater and swimming with a weight. These little exercises will get you to feel at home in the water. Then you move on to Scuba; how to enter the water, ditching and donning your equipment, buddy breathing, free ascents and the physics and physiology behind diving. At the end of this twenty hour course there is a laboratory practical in the pool, a written exam, and an open water graduation dive. When you complete the course you get



a card which certifies you as a diver. This card is needed to rent or refill Scuba tanks. Since the NAUI card is recognized all over the world, it is a good idea to be certified a NAUI diver.

Why the certification hassle? Well, the great majority of diver injuries and deaths are caused by an inexperienced diver panicking and zipping up to the surface. A diver can be injured seriously or fatally from depths of 30 feet. At 30 feet the pressure is double what it is on the surface, if your lungs are filled at 30 feet and you shoot up toward the surface (assuming you make it) your lungs will be twice as full, or more probably, busted. This effect is from Boyle's Law and can occur even as shallow as 8 feet. It is one of the things you learn about in a NAUI course.

Let's say you are certified, or being certified, and you would like to do a little diving. Well, you are not alone. There is a diving club on campus very happy to have new members. They are called the Aqua-fin-atics and they are a group of guys who are really interested in diving.

In the past four years the club has existed, they've found wrecks, rocks and salvagable antiques. These include old bells, steering wheels and even pistols from sunken ships. They organize dives, get guest speakers, show films and display new equipment. They have been diving in and around the Twin Cities, in Christmas Lake and Square Lake, but prefer Superior because of its clarity, accessability and interest.

The club is open to everyone, from beginning to expert, and will bring you to many points of interest in as little as 20 feet or as much as 100 feet of water. The fee is $5 the first year which includes patch, dive logs and card, and $2 in subsequent years. The Aqua-fin-atics are associated with Smith Diving Company which will help you save a little if you are thinking of investing in Scuba equipment.

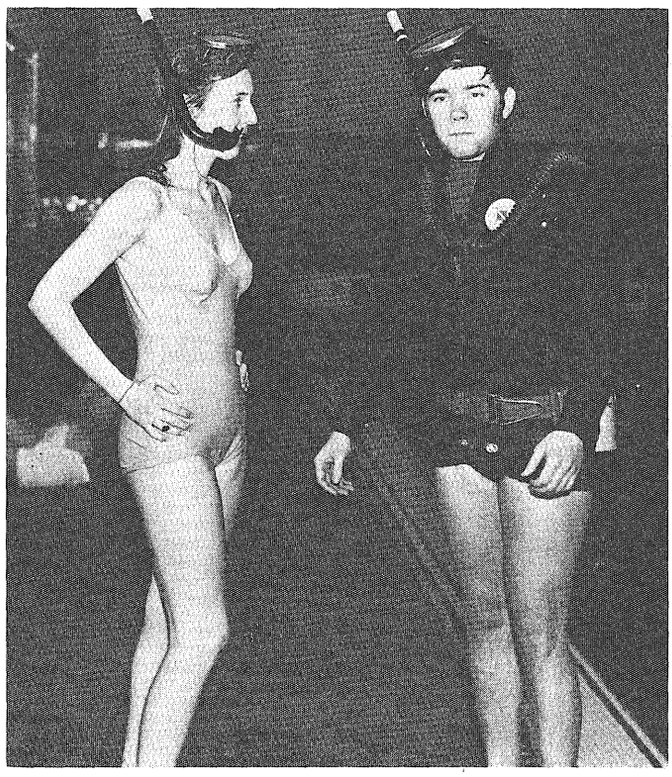
With proper precautions taken, the underwater world can be an inviting, vast, new wilderness, open to everyone; young and old, male and bikinied female.

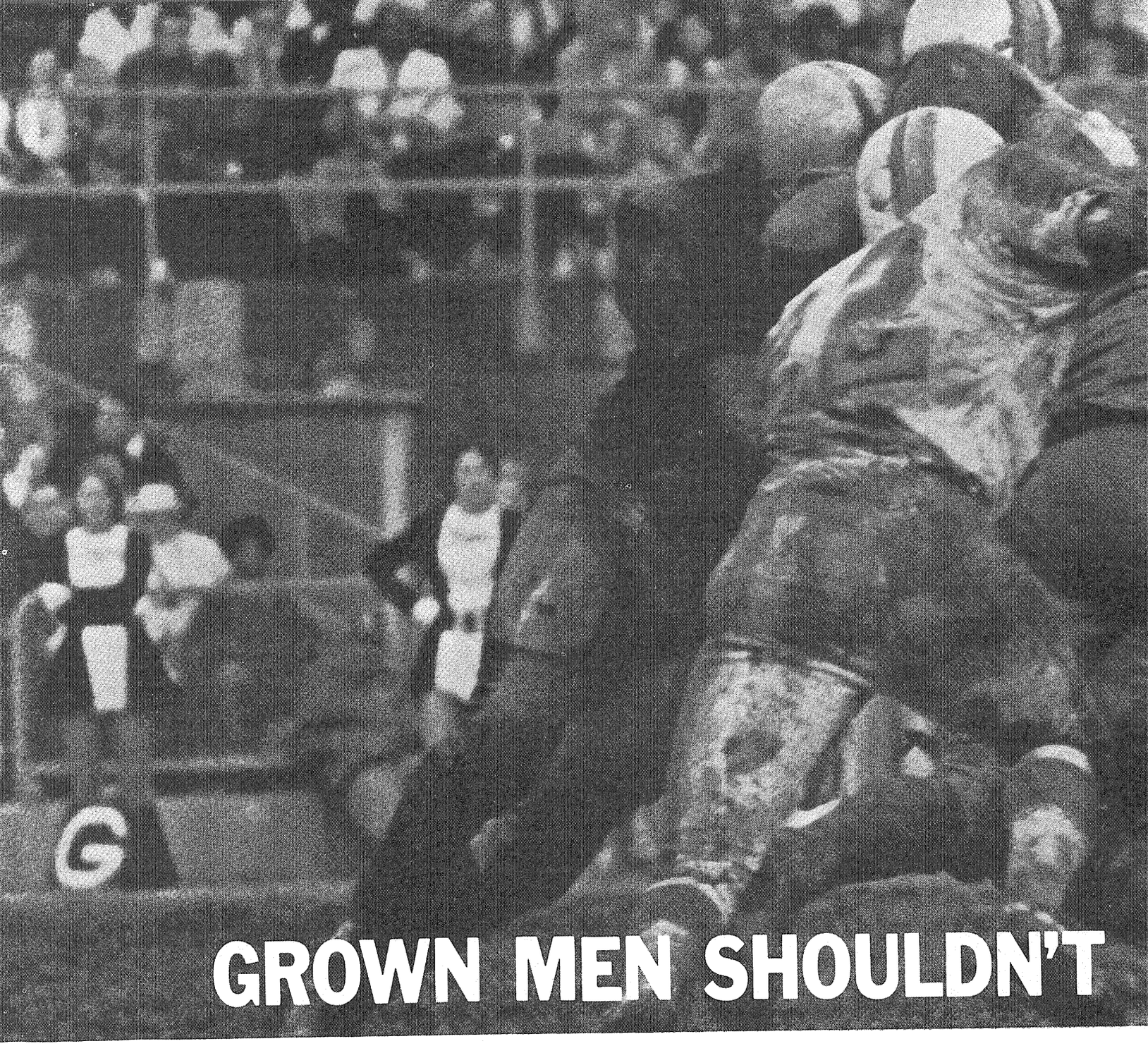
The next meetings of the Aqua-fin-atics will be at 7:30 p.m., room 215, Cooke Hall on May 4 and May 11.

Above left: NAUI class in session in Cooke Hall swimming pool.

Above: Two members of the Aqua-fin-atics preparing to dive into Lake Superior (water temperature 32°).

Below: NAUI instructor Ralph Swanson wearing scuba gear with student in skin diving equipment.





GROWN MEN SHOULDN'T

Soon tests will begin on a bright idea for roofing stadiums with stainless steel balloons. And nickel's helping make it happen.

It sounds like something out of Jules Verne. Actually, it's fresh out of our advanced design studies.

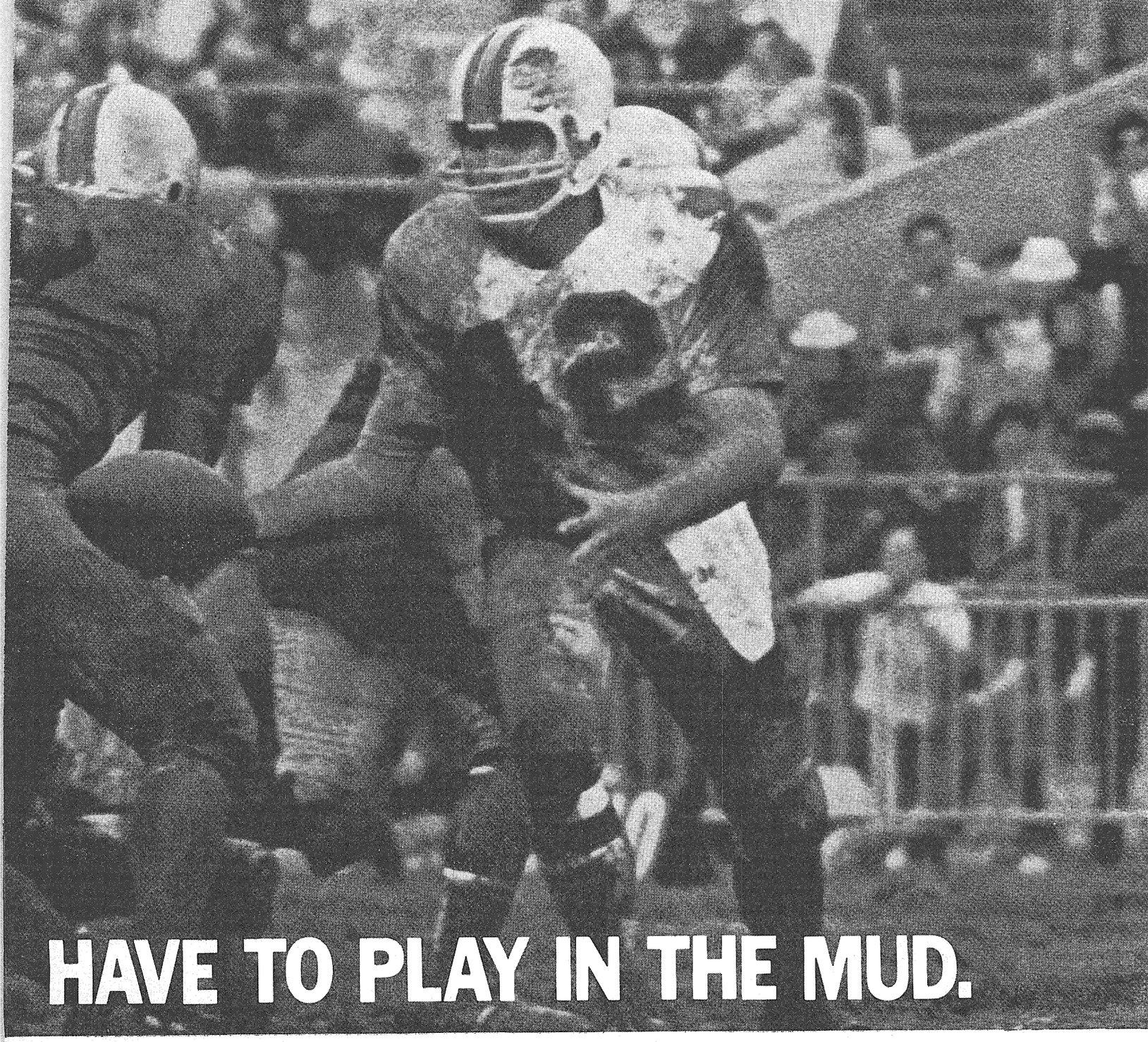
A gigantic, *inflatable* metal lid that can be stretched across a football stadium without any pillars or posts of any kind.

The idea is so mind-boggling that most people have a hard time visualizing it.

Think of a pie that's hollow inside, with the bottom and the top made of a metal skin only 1/16th of an inch thick. When the air is pumped into the pie, the whole thing gets so rigid it can be jacked up into place over the field and never even flutter during a windstorm.

The weather stays outside, the players don't slide around on their backsides, and the spectators don't drown. Somehow, the whole thing seems a little more civilized than a public mud bath.

And the cost could be as little as 1/3 of a conventional trussed roof.



HAVE TO PLAY IN THE MUD.

The metal is nickel stainless steel. The nickel is there to make the skin easier to work, and to give it the necessary toughness and strength. Plus corrosion resistance.

It's a fascinating idea, this revolutionary roof of ours, and scale models are about to be thoroughly tested.

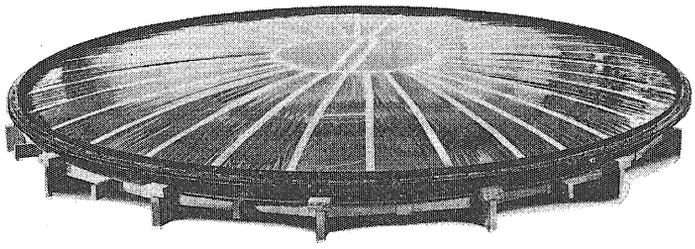
But the point of the story is this. Just as our metal is a helper, one that makes other metals stronger, or easier to work with, or longer lasting, so International Nickel is a helper.

We assist dozens of different industries all over the world in the use of metals. We offer technical information. And the benefit of our experience. Often, Inco metallurgists are able to anticipate alloys that will be needed in the future, and to set about creating them. Sometimes, we come up with whole new concepts—like a stainless steel balloon for a stadium roof.

This kind of genuine helpfulness, we figure, will encourage our customers to keep coming back to us.

And that helps all around.

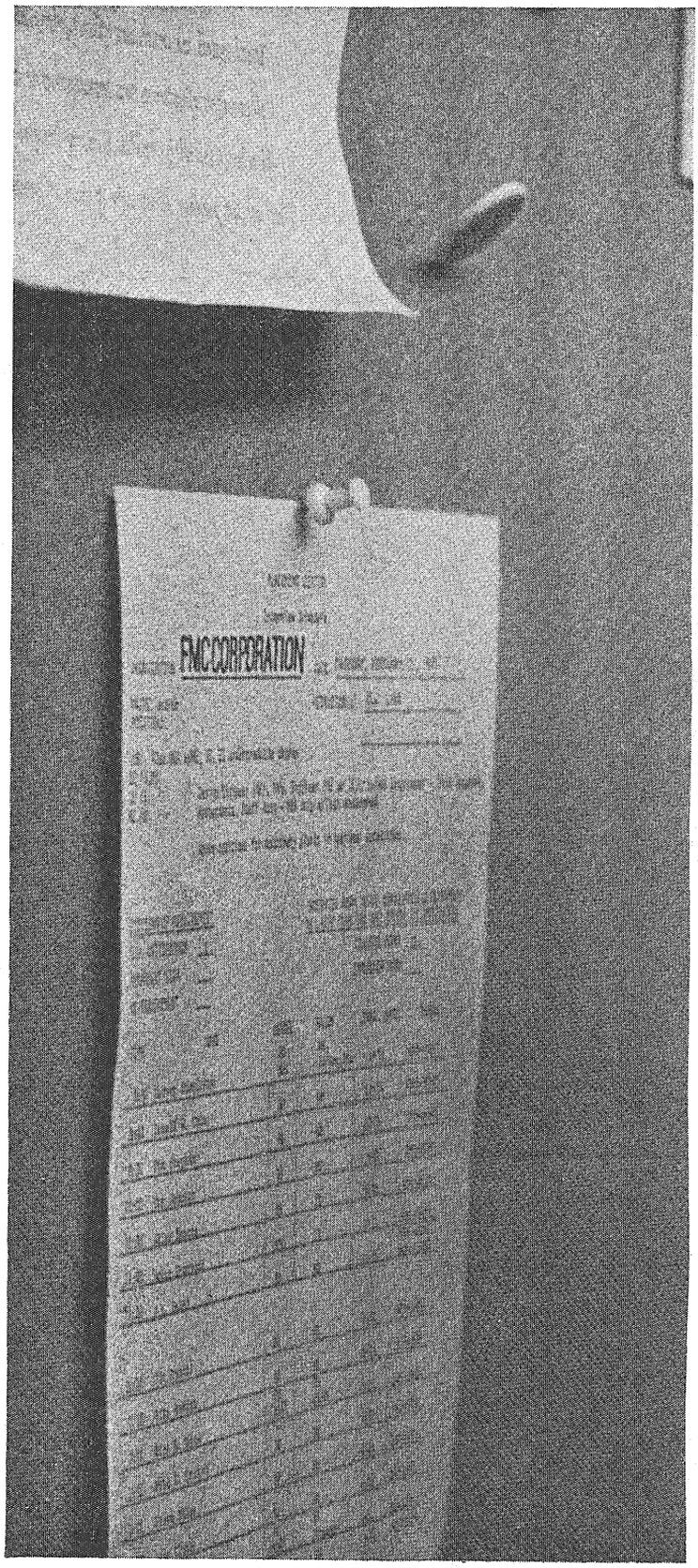
The International Nickel Company, Inc., New York, N.Y. The International Nickel Company of Canada, Limited, Toronto. International Nickel Limited, London, England.

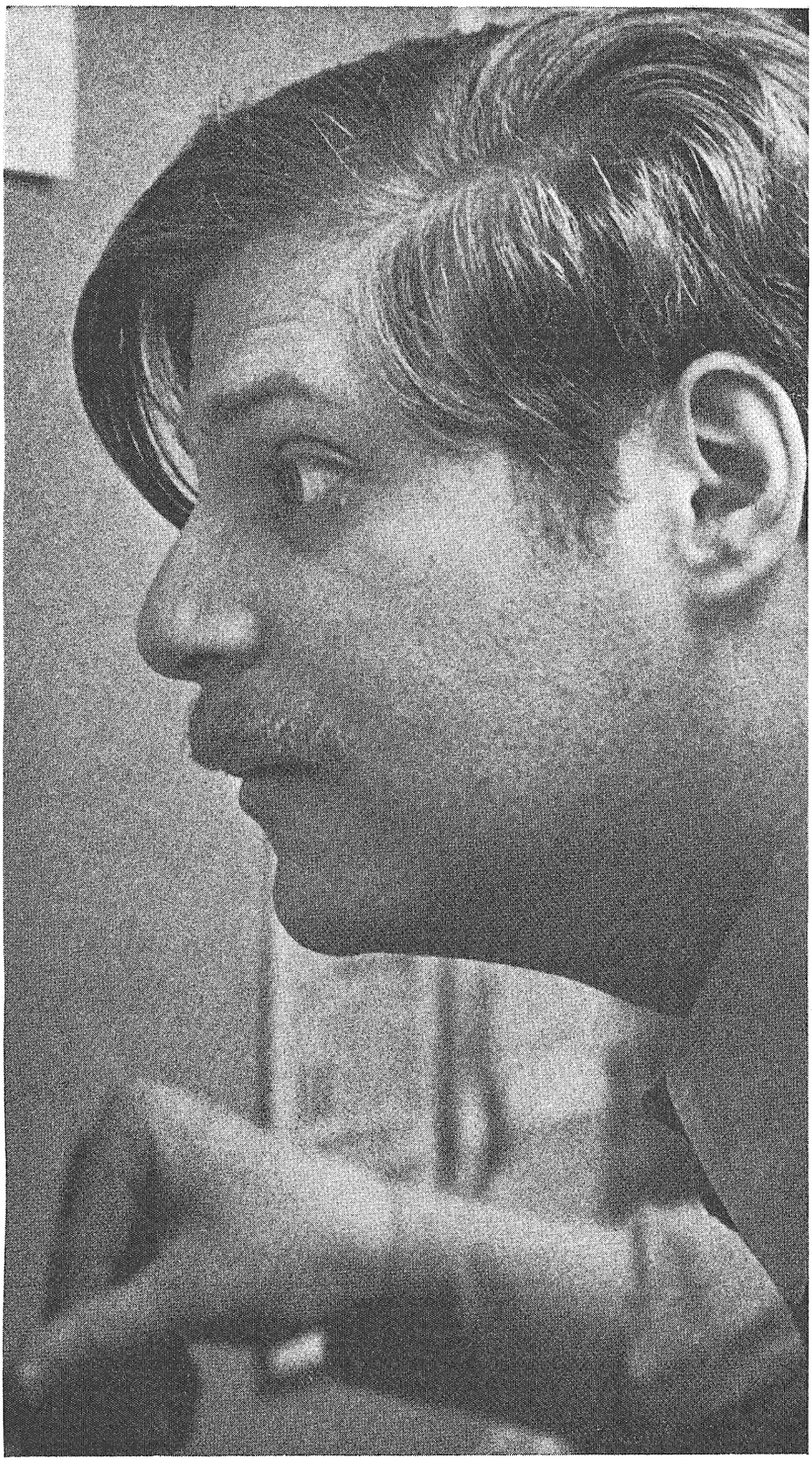


Model test roof of nickel stainless steel.

INTERNATIONAL NICKEL HELPS

Don't let our name confuse you.





On some campus in the U.S. this year a well-intentioned interviewee is going to confuse us with the Foremost Machine Company or some other FMC.

We'll understand.

Having only letters for a name might be sophisticated in some circles.

But sometimes it's just plain hard to remember.

Perhaps we should explain how it came about.

FMC doesn't mean Ford or Foremost or anything else but FMC. Way back long ago it used to mean Food Machinery Company. And later on, it stood for Food Machinery and Chemicals.

But 10 years ago because we'd become so diversified, we dropped the name, although for obvious reasons we kept the initials.

It makes sense. We became the nation's largest producers of rayon. We built Deep Dive for the navy's underwater salvage teams. And we continue to turn out such diversities as railroad cars, printing presses, cranes, barges, compact tractors, automated food plants, and dozens of industrial chemicals. The list goes on and on.

Most of what we produce never gets seen by the public, so our name is seldom visible. Worse, it sometimes gets confused.

So remember: FMC means FMC. If that still doesn't do it for you, write us at Box 760, San Jose, California 95106 for our free brochure "Careers with FMC." Or see your placement director for an interview. We're an equal opportunity employer.

fmc CORPORATION ®

FMC CORPORATION

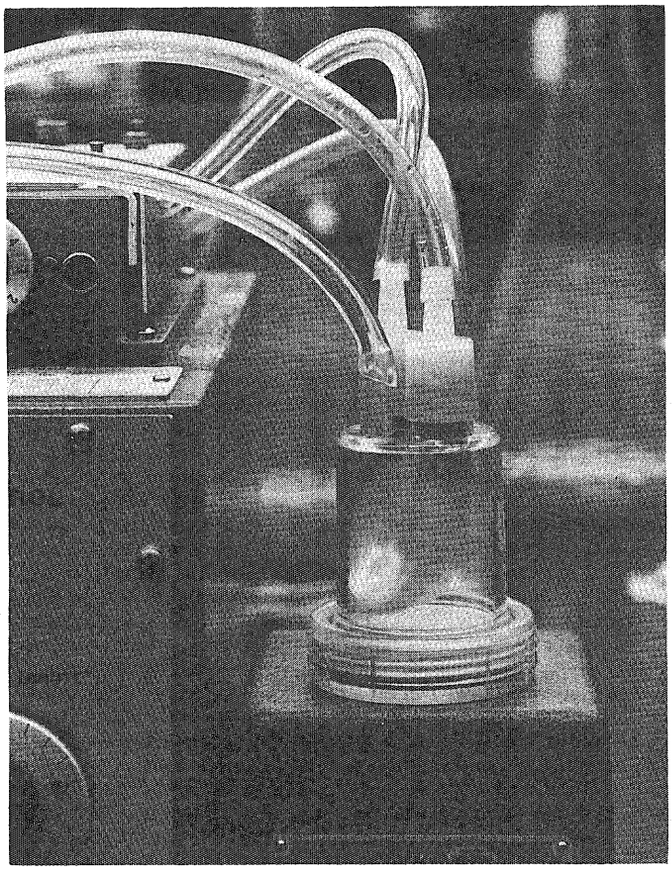
Remember us by our initials.

What's New

...in Science and Engineering

Hollow Fiber Membrane Products

Three totally new, hollow fiber membrane products have been introduced. Compact and reusable, they require no special auxiliary laboratory equipment to operate and can be applied to numerous laboratory processes including concentration, fractionation, and purification. The three devices are produced principally as demonstration or laboratory bench-scale processing tools for biological, biochemical and pharmaceutical work.



Each device contains 1,000 square centimeters or about one square foot of membrane transfer area. All of the devices operate somewhat differently than membrane mechanisms based on the conventional reverse osmosis process.

All three of the devices can be utilized for the concentration of biological or heat-sensitive materials.

The Osmolyzer HFO-1 is designed to concentrate low molecular weight materials by rapid osmosis. Working on a pure osmosis concept, the Osmolyzer utilizes a cellulose acetate membrane to facilitate concentration of materials as low as 100 molecular weight. A 15 percent calcium chloride brine is utilized on the opposite side of the membrane to create an osmotic pressure of about 1,500 psi.

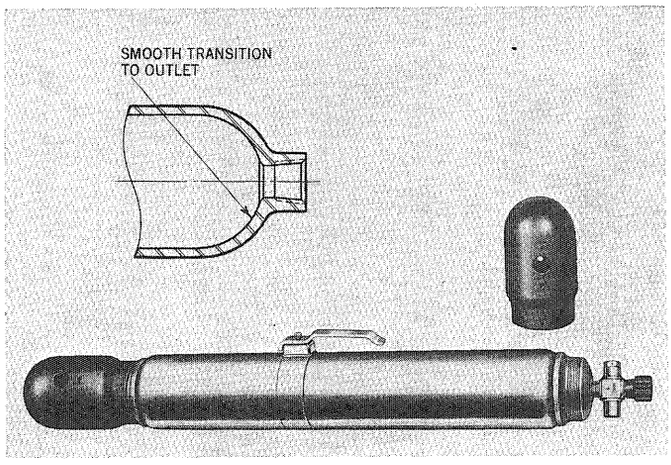
The Ultrafilter HFU-1, based on a specially prepared cellulose acetate membrane, is designed to offer high ultrafiltration rates (five liters per hour per square meter) at low pressure.

Applications for the Dialyzer HFD-1 include purification, fractionation and nutrient addition or waste product removal from bacterial cultures as well as concentration. Based on a regenerated cellulose membrane, it can be used in the purification or sensitive biological materials, fractionation of biological mixtures by molecular weight and concentration of polymers above 5,000 molecular weight.

Cylinders for Pressurized Fluids

Seamless, stainless steel sample cylinders with one gallon capacity, for safe containment and handling of pressurized fluid samples are now available. The cylinders can be furnished with a valve equipped with a rupture disc for positive overpressure protection.

End caps and carrying handles also can be provided to assure safe handling between field or plant storage sites and laboratory facilities.



Spun from seamless stainless steel tubing, the cylinders have no "pockets" to trap fluids. Other features are smooth neck transition for easy cleaning, 1800 psi service pressure, ½" female pipe ends, and double-ended design for versatility. A precision stainless steel plug is supplied for single-ended applications.

Other cylinders are available with capacities from 75 to 1000 cc. The new one-gallon units may be used with all type of fluid samples including corrosive, toxic, hazardous and expensive fluids.

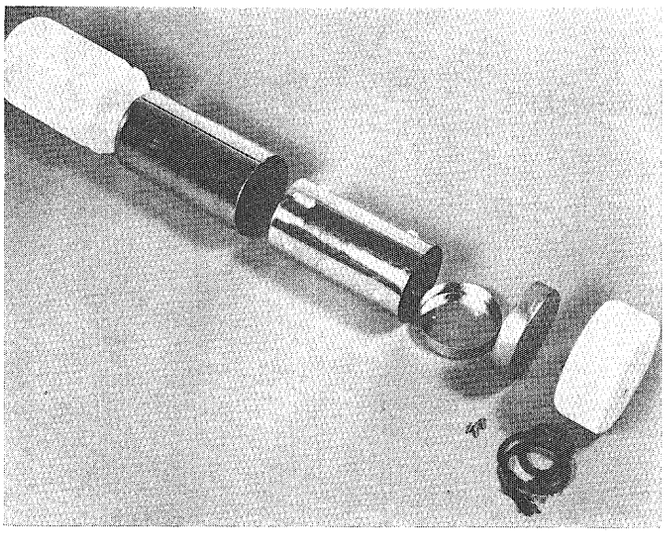
Magnetic Shield Sample Containers

The magnetic shield sample containers (MSSC) used by the Apollo 14 astronauts to bring back to earth lunar rock samples in a magnetically shielded environment were lined with Hipernom magnetic shielding alloy.

Rock samples from the moon's surface carried back by the Apollo 14 crew are undergoing special experi-

Continue on page 16

WHAT'S NEW—Continued from page 14



ments to determine the magnetic properties of lunar material. The high permeability of Hipernom prevents the earth's magnetic field from penetrating through the container and effecting a change in the lunar magnetic field in the samples.

The MSSC is a double-walled container made of Hipernom with a Teflon outer sheath. The container's inner dimensions are 3½ inches in diameter and 6 inches high. The Teflon sheath is machined with vertical ribs to facilitate gripping, and a tether point is machined into the cap sheath and the bottom sheath. A Teflon cord, about 8 inches long, passes through each tether point and is tied in a knot. Nominal weight of the container is one pound.

Since the MSSC is not a vacuum container, it has no sealing mechanism. The cap simply twists off and a knurl on each of the Teflon threads provides a locking mechanism when the cap is replaced.

LOG'S LOG

by Ace & Zeus

INTRODUCTION: This month the Log Team will attempt to define Spring. According to Confucius (similar to confused Zeus), Spring is when one is on the verge of the surge of the urge to merge. With this in mind we leap into (onto) April (or was it May—could have been June—don't July—oh, well March on . . .).

Lush's Cornernerner

When Ace and I tripped into Brucie's Bar and Body Shop last week we noticed the following petition attached to the door:

> March 29, is/was my mother's birthday. This is a birthday petition. We, the undersigned, do duly wish her a happy birthday. It is our fond hope that by signing this petition we may once again declare our allegiance and/or faith in Mother, flag and apple pie. Besides, it butters the old lady up and I never know when I may have to borrow money from her again.

With tears in our eyes we signed.

In honor of Mother, Bruce decided that this month's special should be something to rival the limits of man's imagination. So, that's just what he did—he left it up to your imagination; but just be sure to remember Mother.

Ace's Advice for the Month

If any of you had planned to travel to Duluth for excitement, forget it. During spring break Ace ventured back to the Old Country to check on the situation there.

The only differences which I noticed since my last visit eight months ago were thirteen pregnancies, seven marriages (four of which applied to the previous item), one robbery, four fights, one broken engagement, three operations, two deaths, and fifteen thousand new chuckholes.

I knew it was going to be a bad trip when I had a blowout on the freeway, discovered I had no tire iron, and found my jack was broken (Ouch!). All that Zeus could say was, "Way to go, Ace!"

My major disappoints came under the category of nookie (i.e. girls). For the fourth time in four visits I have failed to take out one certain special girl. While everyone has gone the way of sex, sin, and perversion this blonde beauty has remained unchanged. Everyone wonders what I would want with such a girl, but just the same she S(h)all(y) not elude me next time. How can I fail to corner her the fifth time? (Let me count the ways!)

The weekend was saved on Sunday night when Ace and his old working buddy, Chilly, found two little birds. It wasn't exactly Bob, Ted, Carol, and Alice (it was more like Ace, Zeus, Carol, and Cheryl), but it was a definite improvement over the other two nights.

Well, finally my three days of "relaxation" (which included ten hours of sleep) came to an end. After fond farwells to "Joe Sif", Crotch, Rings, and Wooker Ace stumbled to his faithful Ferd. If anyone ever needed a vacation from a vacation, it was Ace. I guess I can't complain about Duluth too much, though. After all, it put up with Ace for seven years, educated him(?), gave him a reputation and a name, offers him a place for his R&R (er, eh), and most importantly provided him with life-long friends. (or was that fiends?).

Official Daily Bull

Since this is the month of spring, your hero and mine (i.e. Zeus) decided to visit the homestead of the fair damsel who has been haunting (could be more like hunting) my mind these past few months.

Now this may not seem like such an unusual journey, but when the travel directions came in an envelope marked "May Allah be with you" (Salamat! even the great(?) Zeus has second thoughts. I became rather disappointed when upon reading the contents I found only two bottomless pits, one whirlpool, and seven little gremlins with sharp hat pins. Besides, would you be worried about a fire-breathing dragon named "Fred"?

The elephant was right, after trying for many, many, many times to get his message across, when it said to the chicken (elephants rarely speak with chickens), "Eggs are only hardest in the softest places!"

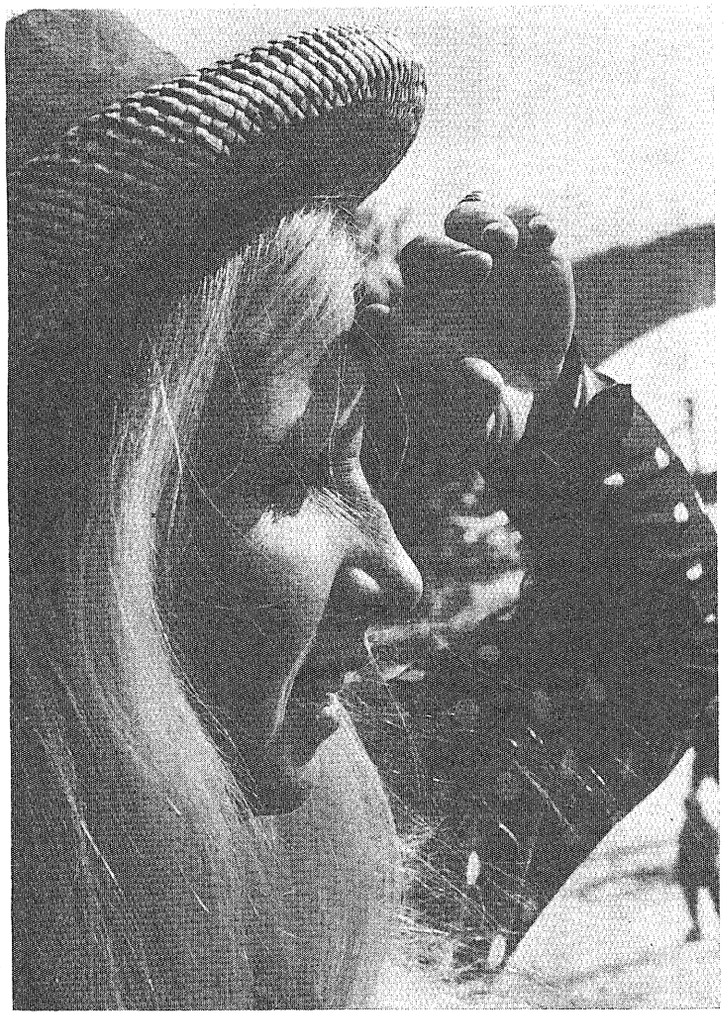
April 16-30

16—Polaroid Day. (Polaroid? That's a cross between a Polack and a hemorrhoid—They both give you a pain in the ace.)
17—Computer Day. Satisfy your externals.
26—Start of National Sheep Week. That's a week!
30—Porcupine Day. Stick someone, quill you?

May 1-15

1—May Day—May 1. (Becky second, Kris third, Sue fourth. Ikik gets the fifth, and Bruno gets picked last.
7—Dog Race Day.—IT coeds were running hard in the third heat but were aced out by Bruno.
13—Bread Day. No sooner spread than done.

CONCLUSION: To conclude this month's edition of the continuing story in the lives and side lives of the E-F Force we find our heroes about to be eaten (?) by cannibals, as Zeus says to Ace, "Here we are about to be seasoned by spices from Molly's unbrownable sink, next to the hairy simian corral and what can we say?" Whereupon Ace replied, "Beware the Curse!" Zeus agreed, "Yes, CURSES is coming." Perhaps you also have the curse. Be sure to check the May mag to answer this highly pertinent query.



Miss

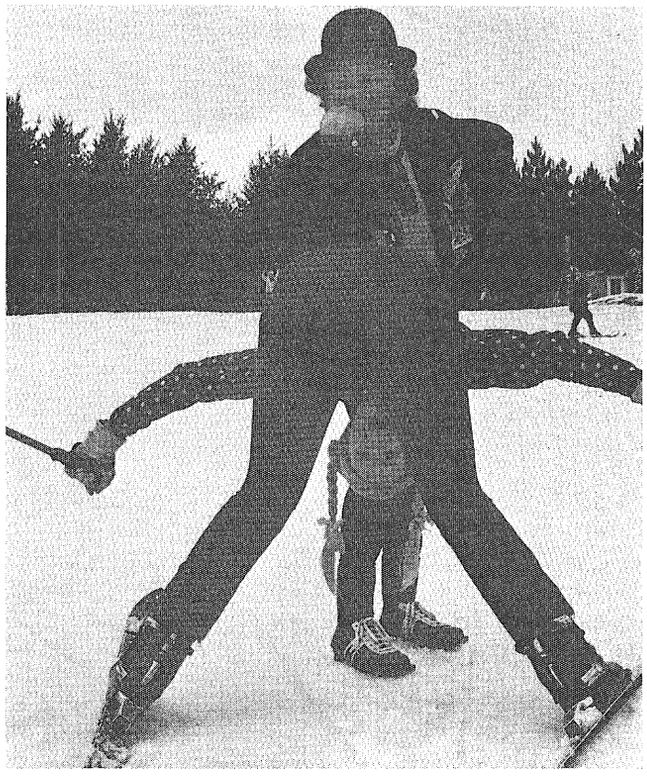
April

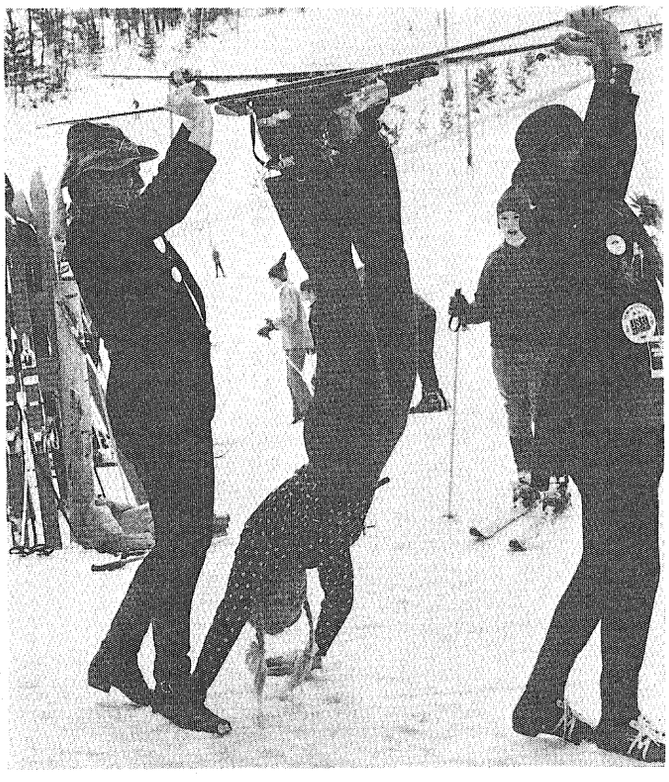
Gloria

Fritz

Since winter is definitely out of the picture, we thought that Miss April, Gloria Fritz, may be able to brighten your memories of winter. Gloria worked this winter as a ski instructor at the Lake Geneva Playboy Club. She started skiing at the age of 2 and (regardless of how she appears to be doing in these pictures) has become very proficient at it.

Skiing is not the only thing that interests Miss April. She is a commercial artist and is currently studying nursing at St. Mary's. We might suggest that she combine her talents and do medical drawings of skier's injuries. We're not sure how much demand there is in that field, but we are sure that Miss April would be in demand in whatever field she decides upon.





Splinters

by RALPH POLKINGHORNE and BARRY JOHANSEN

—vilitas et crudus semper ternam

Werner von Brauns Mother: "Ach Himmel, Werner, you missed school three times this week."

Werner: "Ya, but only by a couple hundred yards."

• • •

E.E. "What do you call a Jewish boy who joins a Monastery?"
M.E. "A Schmunk?"

• • •

A local preacher recently announced that there are 776 sins. He is currently beseiged with requests for the list by college students who think that they might be missing something.

• • •

Ag.E. "I went out with a girl, last night, who really has something."
E.E. "So?"
Ag.E.: "Well, I think I've got it."

• • •

While riding on the second deck of a London bus, an elderly gentleman noticed that the conductor would hang a short piece of string over the front of the bus at every other stop. After this the driver was heard to utter many profanities. The old man asked what all this meant and was told that the drivers brother was being hung tomorrow and this was just the conductors way of teasing him.

Lars and Helga were driving along in their Volvo when they came across a dead mother skunk in the road.

Helga: "Lars, all the little skunks are going to freeze to death if we leave them by the side of the road."
"Vat should ve do?"

Lars: "Put dem in the car and ve'll keep them varm."

About two miles later,

Helga: "Lars, they're still freezing, vat should I do?"

Lars: Vell, put dem under your coat to keep dem warm."

Helga: "But vat about the smell, Lars?"

Lars: "Oh, don't you worry, dey get used to it."

• • •

The human brain is a wonderful thing. It starts to work as soon as you wake up and doesn't stop 'till you called on in class.

• • •

The old woman had lived alone for the last twenty years except for her two pet monkeys. But, one day, one died and the other died the next day from a broken heart. Hating to part with them, even in death, she took them to a taxidermist who asked if she wanted them mounted. "Oh no," she replied, "just holding hands is good enough."

• • •

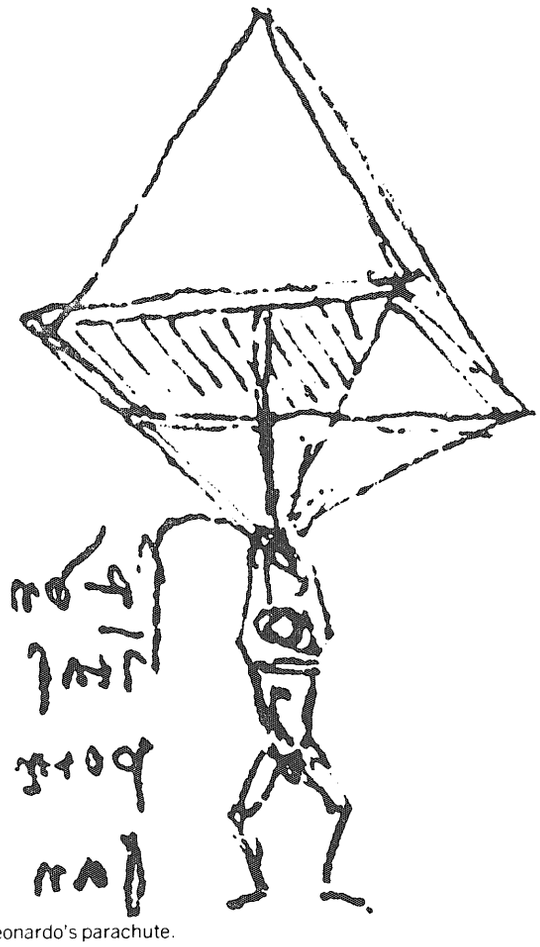
Coeds are like pianos, if not upright, grand.

• • •

Marvin is so distressed, he got a military brush and a pair of pink jammies for Christmas. He doesn't know if he should join ROTC or become a forester.

An equal opportunity employer.

Calling us just a telephone company is like calling Leonardo DaVinci just a painter.



Leonardo's parachute.

General Telephone & Electronics is involved in domestic and international telecommunications . . . home entertainment . . . every type of home and industrial lighting . . . computer software systems . . . and all phases of advance research.

But please don't get us wrong. We started in the telephone business. We grew up in the telephone business. And we're still very much in it.

So we don't really mind your referring to us as just a phone company.

It simply serves to remind us of how far we have come.

GTE

GENERAL TELEPHONE & ELECTRONICS

On your way up in engineering, please take the world with you.

The best engineers are far from happy with the world the way it is.

The way it is, kids choke on polluted air. Streets are jammed by cars with no place to go. Lakes and rivers are a common dumping ground for debris of all kinds.

But that's not the way it has to be.

Air pollution can be controlled. Better transportation systems can be devised. There can be an almost unlimited supply of clean water.

The key is technology. Technology and the engineers who can make it work.

Engineers at General Electric are already working on these problems. And on other problems that need to be solved. Disease. Hunger in the world. Crime in the streets.

General Electric engineers don't look for overnight solutions. Because there aren't any. But with their training and with their imagination, they're making steady progress.

Maybe you'd like to help. Are you the kind of engineer who can grow in his job to make major contributions? The kind of engineer who can look beyond his immediate horizons? Who can look at what's wrong with the world and see ways to correct it?

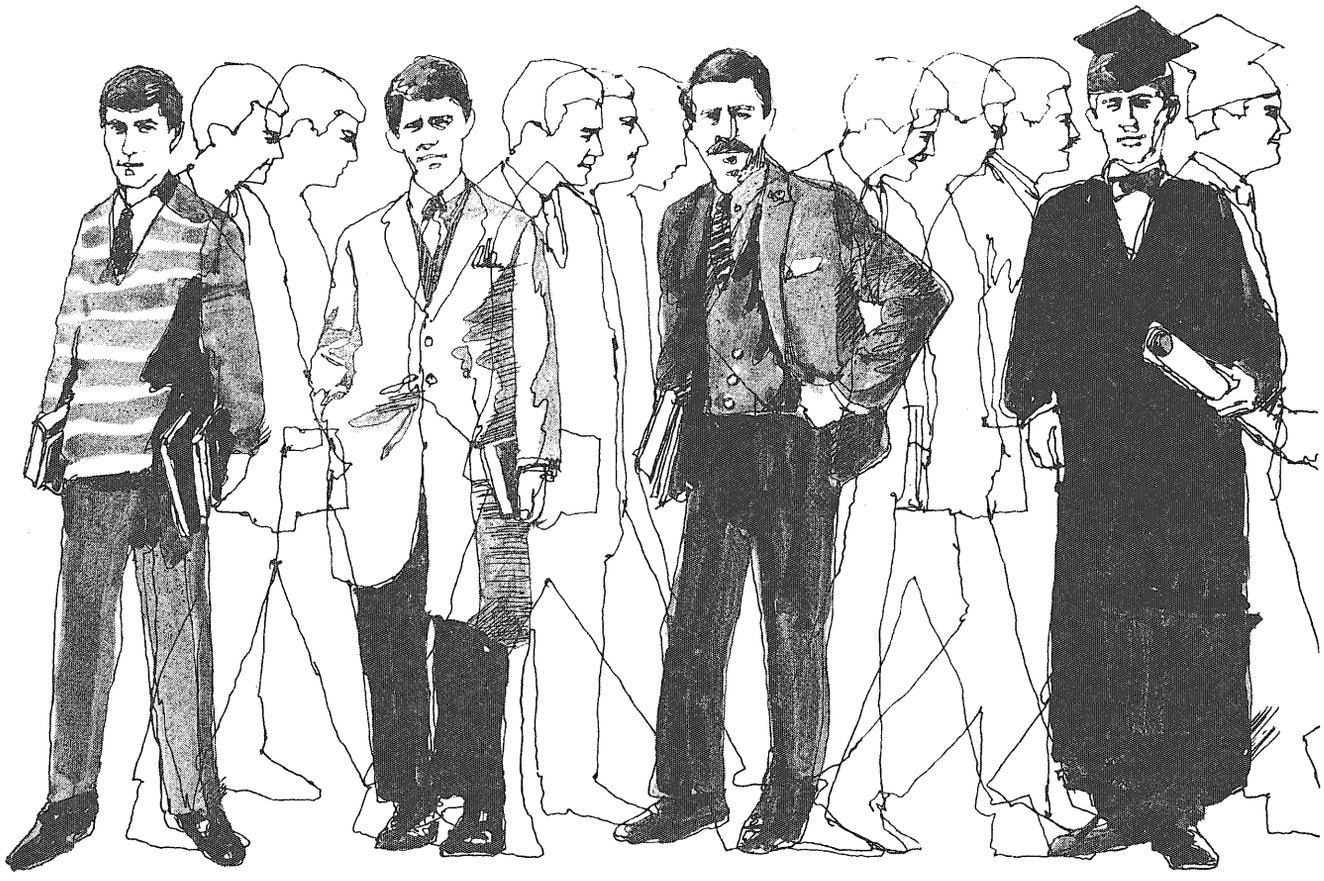
If you are, General Electric needs you.
The world needs you.

GENERAL ELECTRIC

An equal opportunity employer

TECHNOLOG

UNIVERSITY OF MINNESOTA MAY, 1971



Senior!
While you were in college, Westinghouse built 13 new plants, boosted sales $1 billion, got 2,000 new patents.

Nice growing figures. But maybe the figures aren't as important as the areas we're growing in:

Housing, mass transit, health care, education, crime abatement, urban development, pollution control, nuclear power, oceanography, computer-based information systems.

Talk with our campus recruiter. We're looking for engineers to grow with us. Electrical, mechanical, chemical, industrial. And finance/accounting people.

If you can't wait for the recruiter, write today to George Garvey, Westinghouse Education Center, Pittsburgh, Pa. 15221. An equal opportunity employer.

You can be sure...if it's Westinghouse

TECHNOLOG

VOL. 51, NO. 8 | Official Student Publication of the Institute of Technology, University of Minnesota | MAY, 1971

FEATURES

DEPARTMENTS

THIS MONTH'S COVER

"Then and Now" was the theme for this year's E-Day. The comer is a collection of past and present E-Day buttons. Wait a sec . . . where did that EF button come from? The EF force strikes again!

MEMBER OF ECMA

Published monthly, October through May. Second-class postage paid at Minneapolis, Minnesota. Office: Room 2, Mechanical Engineering Building, University of Minnesota, Minneapolis, Minnesota 55455. Telephone: 373-3298. Printer: Bruce Publishing Co., 2642 University Avenue, Saint Paul, Minnesota 55114. Publisher's National Representative: Littell-Murray-Barnhill, Inc., 369 Lexington Avenue, New York, New York 10017 and 737 North Michigan Avenue, Chicago, Illinois 60611. Publisher's State and Local Representative: University Engineering Magazine Advertising, F. P. McGrath Manager, Box 14026 University Station, Minneapolis, Minnesota. Telephone 612-225-0708. Member of the Engineering College Magazines Associated, Gordon Smith, Oklahoma State University, Stillwater, Oklahoma. Subscription rate: $4.00 per year, single copies 50 cents. Advertising rates upon request. Any opinions expressed herein are not necessarily those of the Institute of Technology or of the University of Minnesota.

1971

QUEEN COLLEEN

AND

ST. PAT

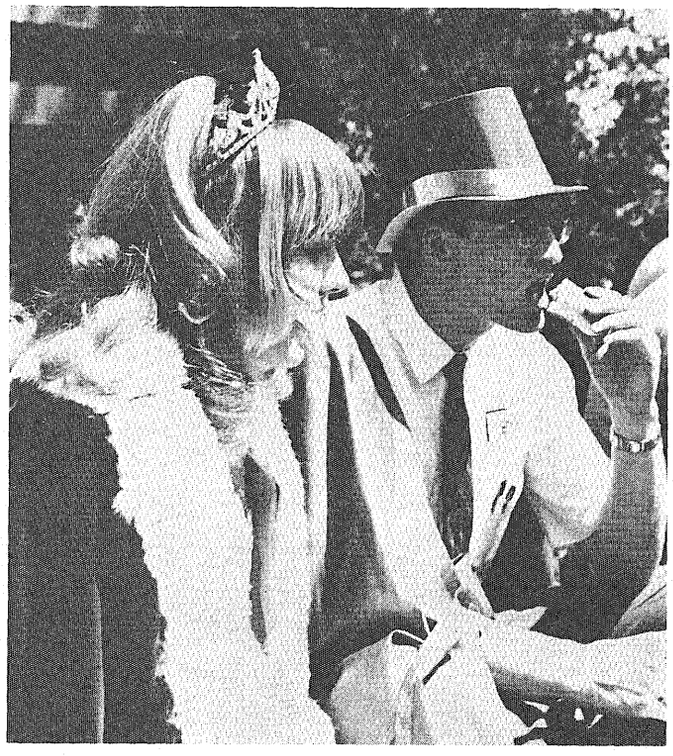
Photos by

Don Neal

&

Brian Johnson

Queen Ginny Eisinger



Jeff Otto

Ginny Eisinger

Princess
Maureen Mulvey

Princess
Colleen Jensen

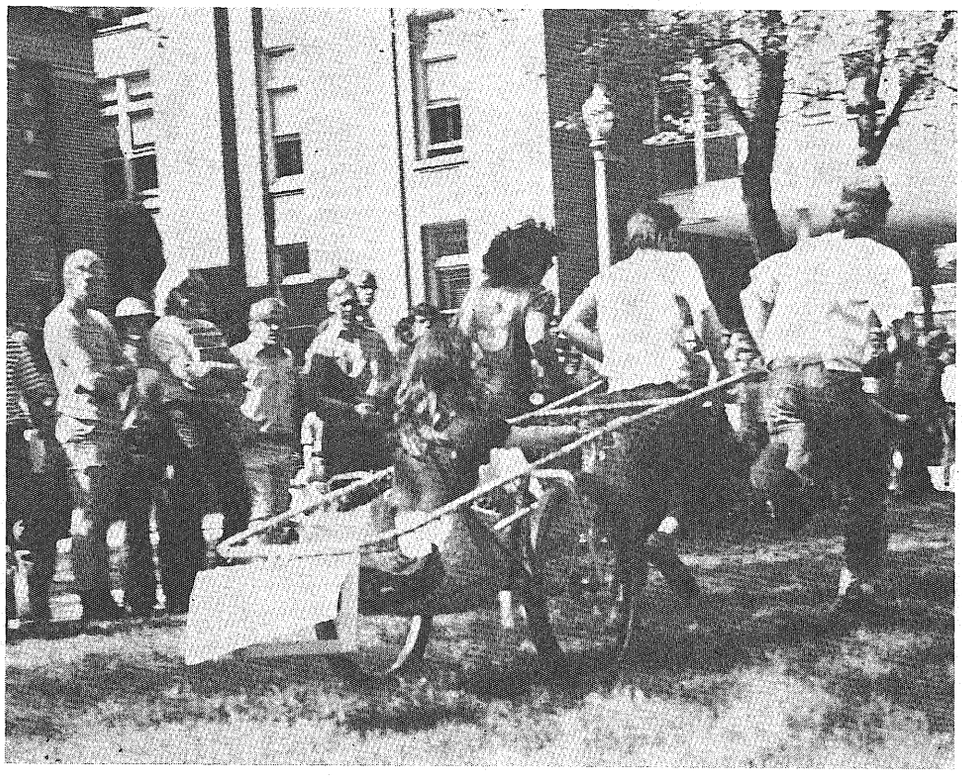
E-DAY

Not then... but NOW!

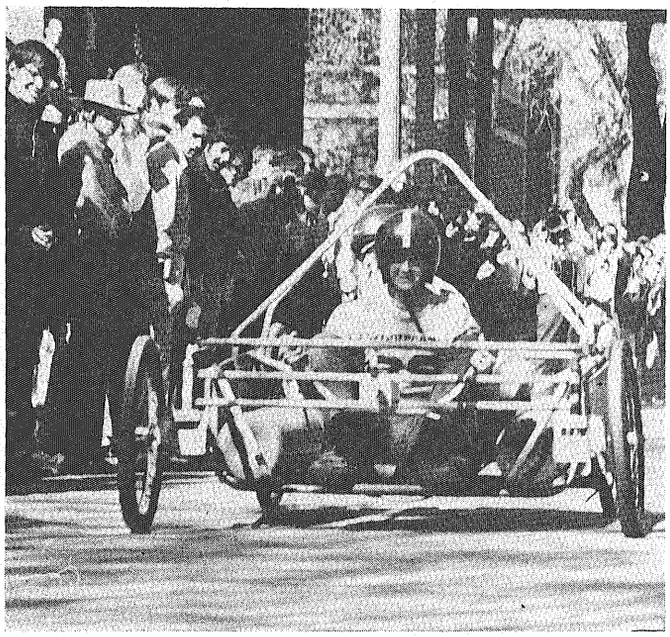
Photos by

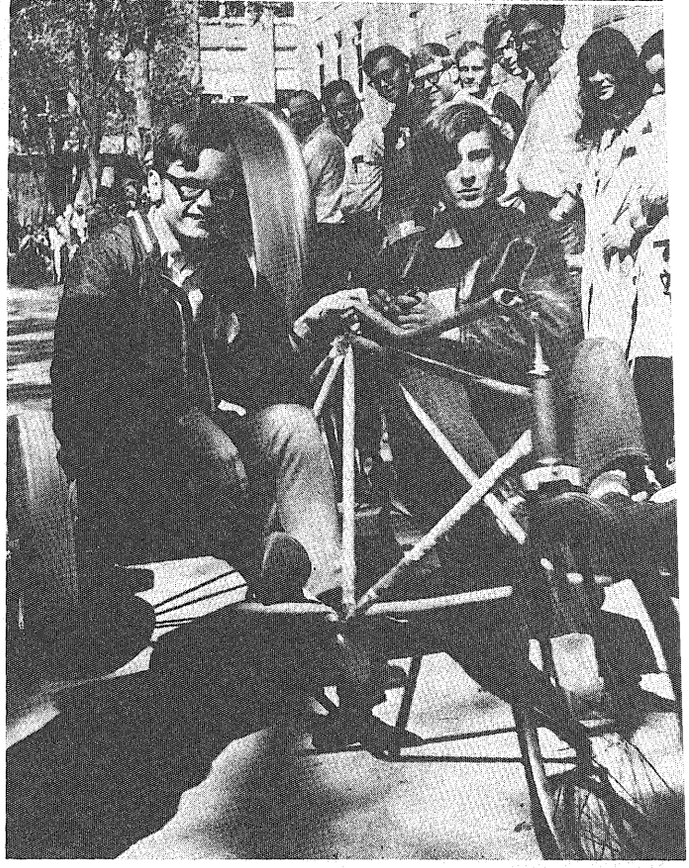
Don Neal
Brian Johnson
Kevin Stranberg

The Kappa Eta Kappa chariot crew comes in second against Triangle.



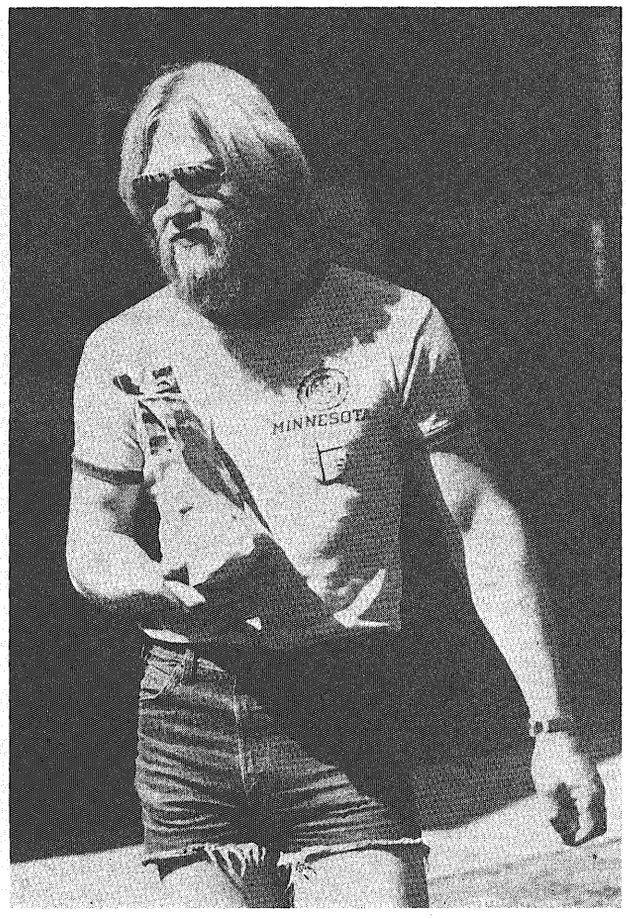
Below: The Aero Car roared down the "strip" with 2100 pounds of compressed air behind them.



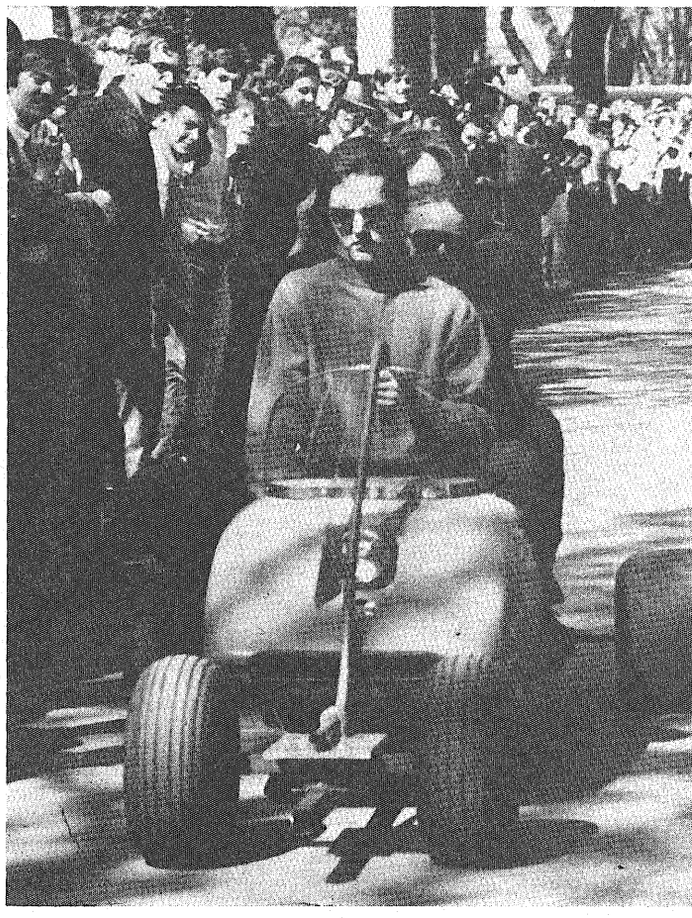


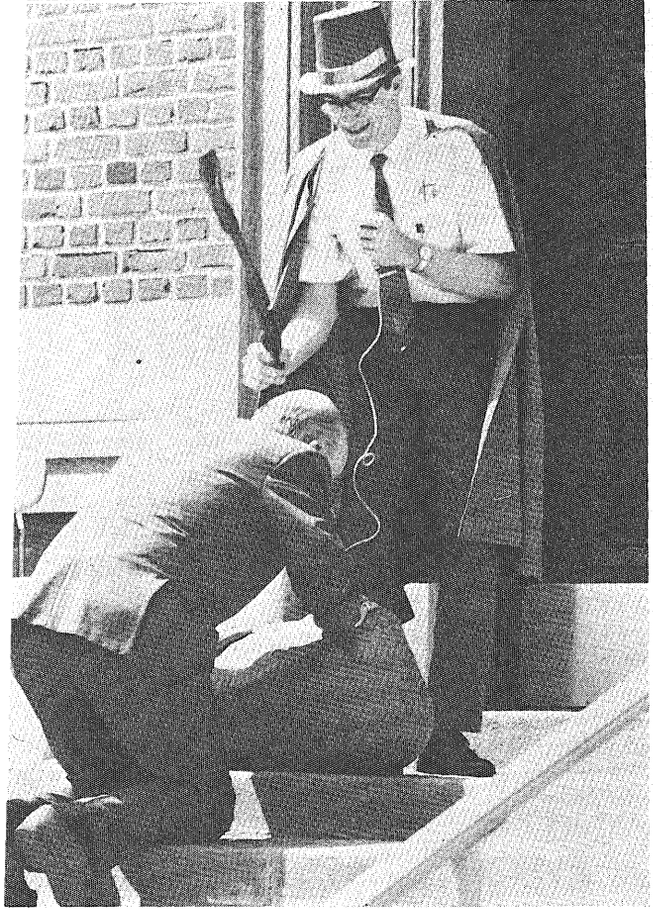
Above: The ME's car, a huge flywheel started by a motorcycle, spun its way down the dragway.

Below: Bill Tuynman peddles his ware—E-Day Buttons.



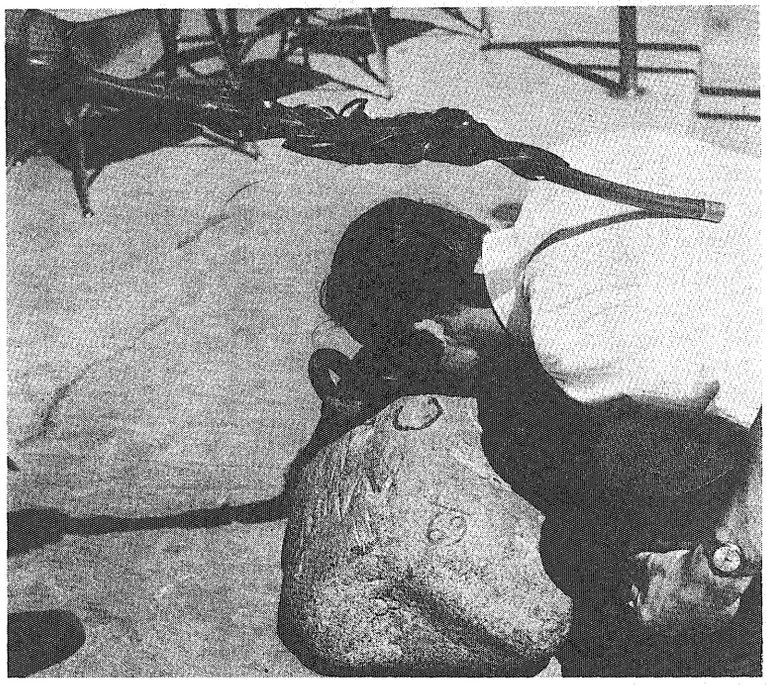
Below: Dennis Parvey whines into first place with an electric car featuring an eight track stereo tape recorder and four speeds. Sitting behind him is his girl friend and a television cameraman.

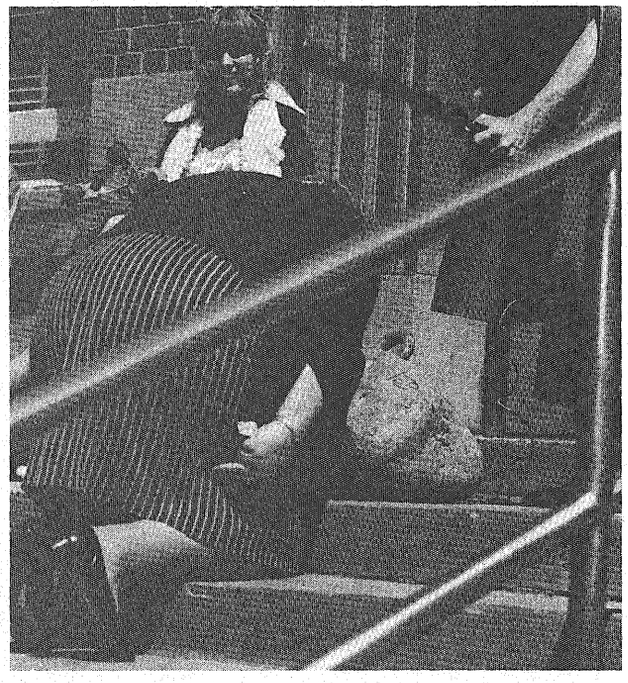




Above: Dean Cartwright is once again dubbed a knight at the proceedings.

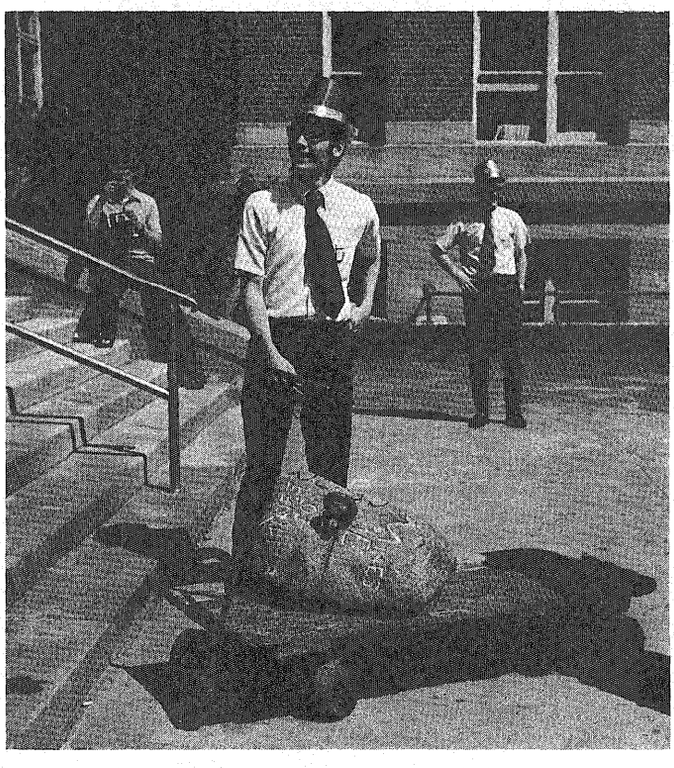
Below: Jeff Otto is dubbed St. Pat as he kisses the "Rock."

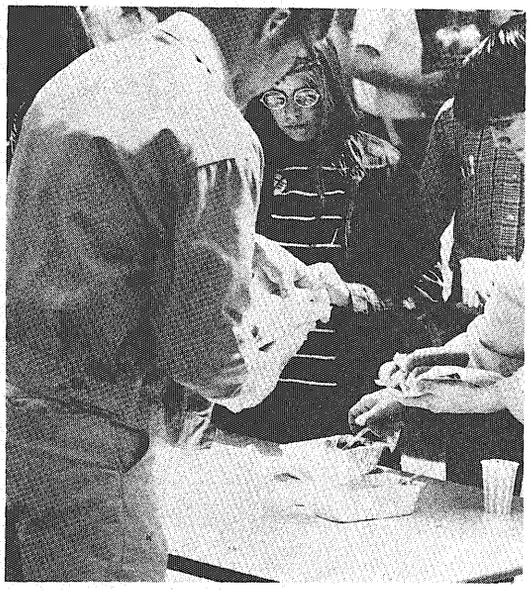




Above: Rose kisses the Blarney Stone.

"Look, we got the Blarney Stone back!"

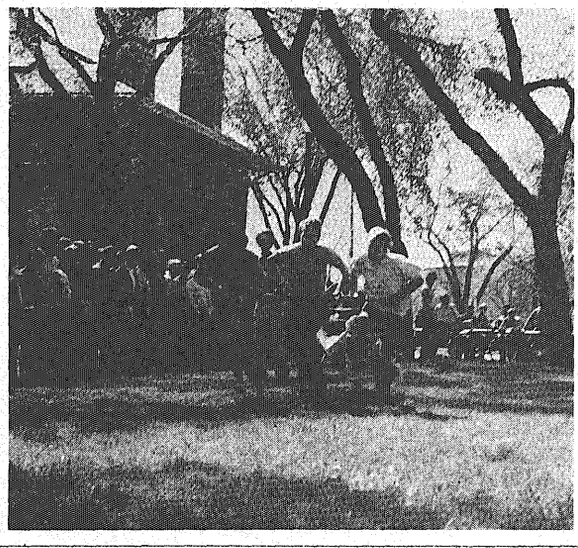


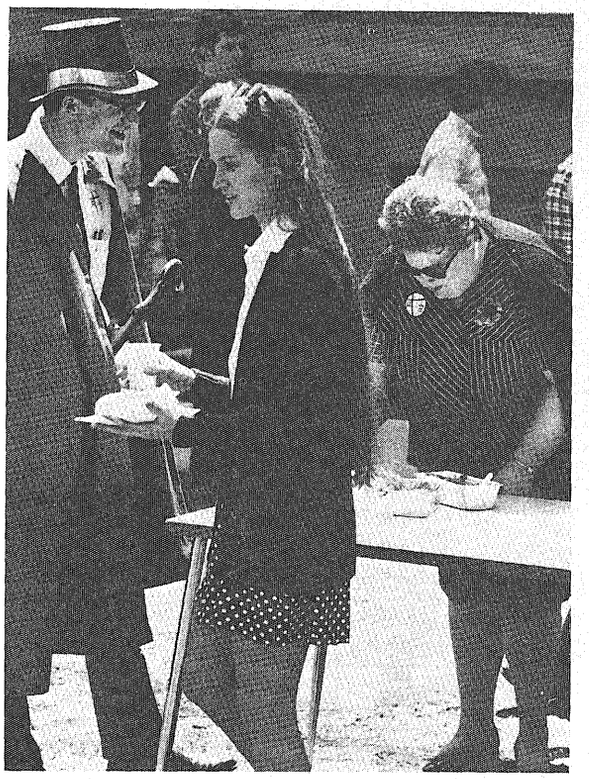


Above: Food!

Below: The Foresters strike again.

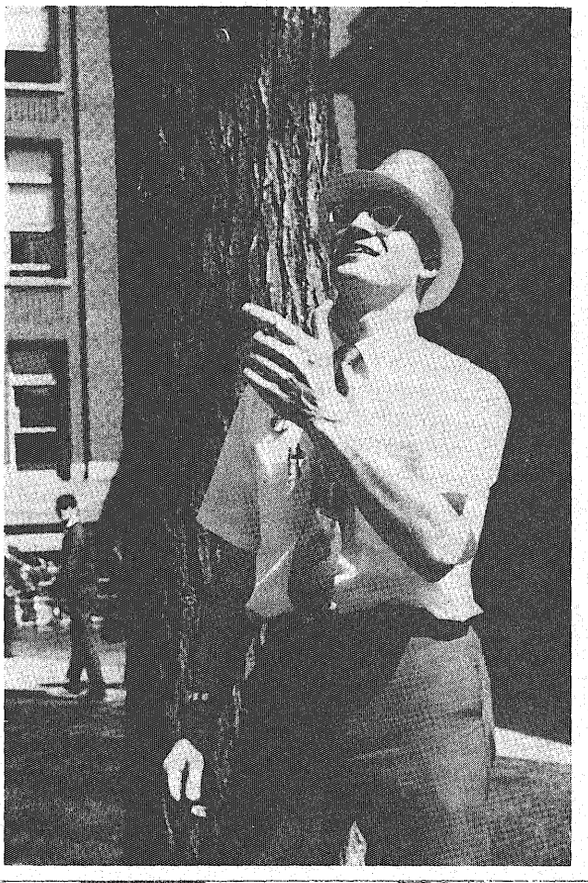
Below: Another Chariot Race

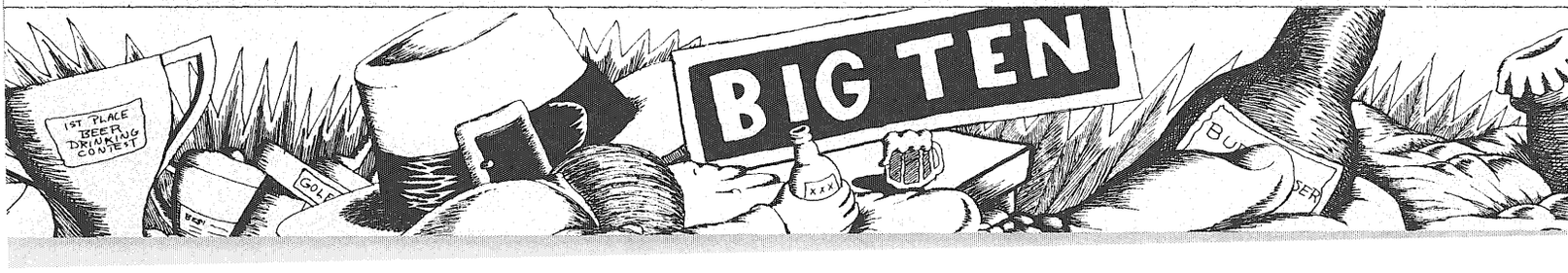


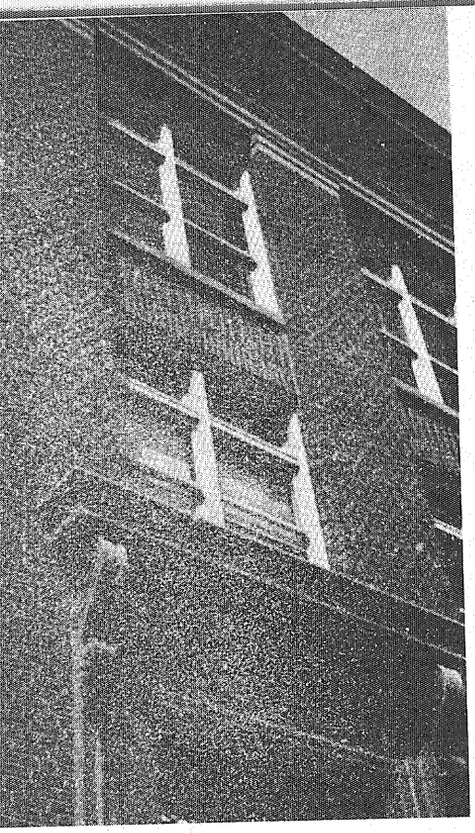


Above: The E-Day Picnic

Below: Jeff Otto decides the outcome of the E-Day car race.

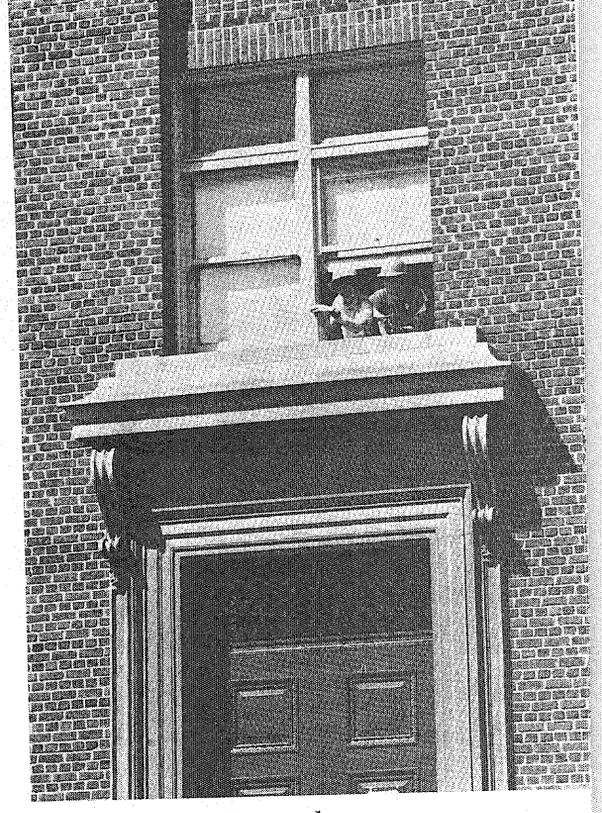






St. Patrick's Day Blizzard?!

by
Barry Johansen



1200 hrs: Two subversives are seen running from M.E. to Main Engineering carrying a small suspicious parcel.

1210 hrs. The militant members of Plumb Bob and their secret police start a search and destroy mission. All roofs are checked for snipers and a systematic shakedown is started in all nearby buildings.

1240 hrs. A lone radical is found and beaten in Main Engineering. The parcel in question is confiscated and the subversive is left for dead.

1300 hrs: An attempt is made to overpower the Secret Police headquarters in T.N.C.E. In the encounter, St. Pat elect, Jeff Otto, is attacked by one of the activists but manages to escape with his life by locking himself in a closet.

1312 hrs: The S.S. manage to deactivate the parcel and toss it out a window before the radicals overrun the office.

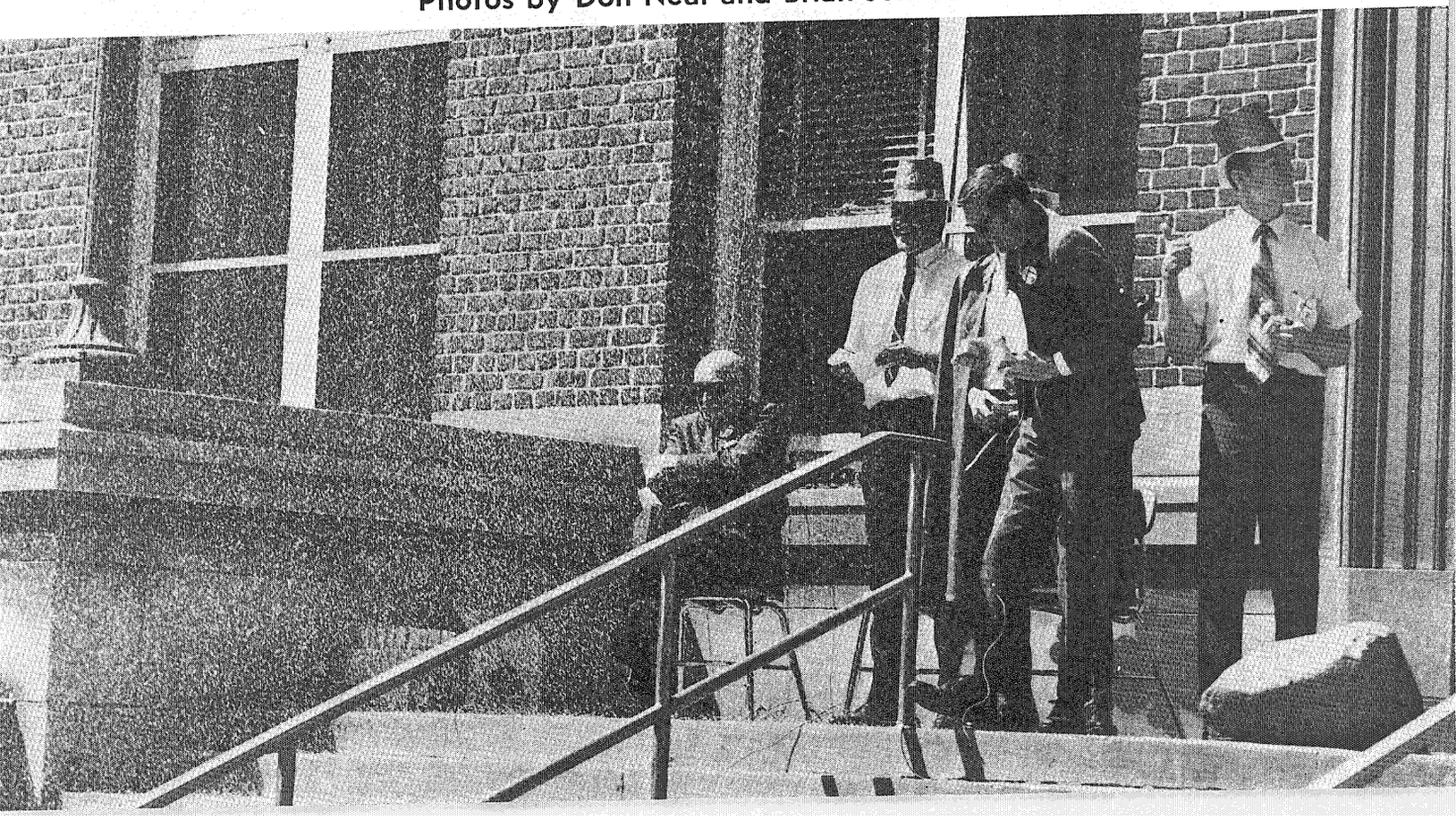
1320 hrs: Three members of the radical element are found trying to reconstruct the parcel. They escape with only parts that were not destroyed.

1331 hrs: Plumb Bob doubles the guard on the Queen candidates.

1335 hrs: Even under the most severe security conditions, the enemy's snipers score a direct hit on the I.T. power structure.

1337 hrs: The enemy is seen fleeing the scene in a stolen chariot.
A further investigation is impending.

Photos by Don Neal and Brian Johnson



What's New

...in Science and Engineering

Transient Signal Recorder

A new instrument which allows direct digital recording of nanosecond transient or single-shot signals has been announced. The new instrument is especially useful for recording random, transient, or slowly varying waveforms in such applications as shock testing, plasma research, radar signal analysis, pattern recognition studies, dynamic testing of semiconductor devices, radiation damage, and

New WD-2000 Nanosecond Waveform Digitizer

seismic and acoustical research. In most applications it replaces the technique of photographing an oscilloscope screen and permits data to be transferred directly to computer for later analysis.

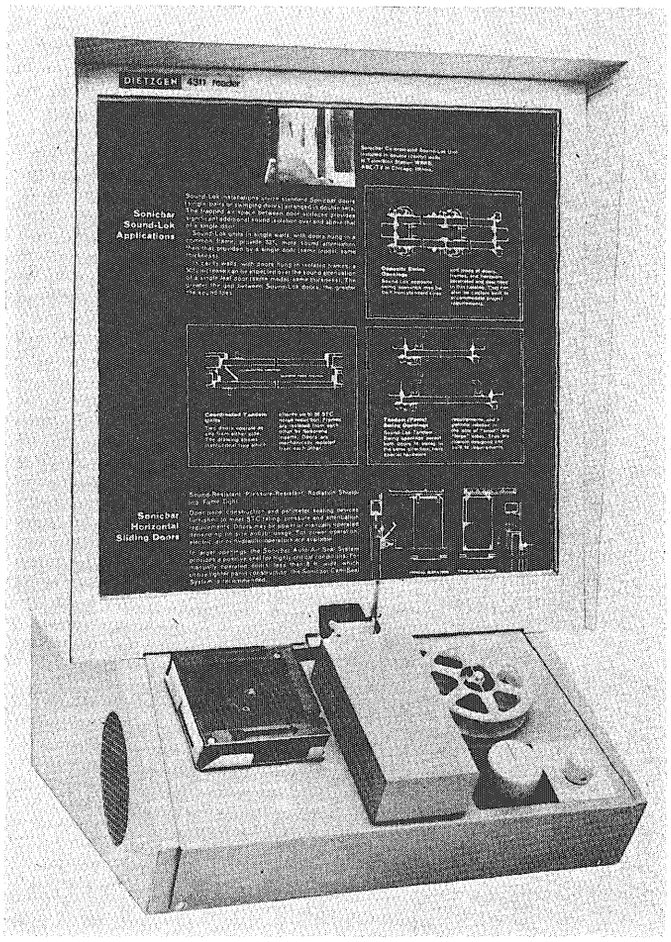
With its input bandwidth of greater than 300 MHz, the digitizer can record any phenomenon occuring over several nanoseconds to twenty milliseconds. The instrument captures a single transient waveform by consecutively sampling the amplitude twenty times over the duration of the measurement. The sampling is done in real time, and an entire waveform is recorded each time the unit is triggered. The captured waveform is held indefinitely by converting the amplitude of each sample into a digital number and storing it in a memory. The contents of the memory are then used to continuously reconstruct the waveform on the instrument's built-in CRT screen. A direct digital output enables the sampled waveform to be transferred to computer, typewriter, magnetic tape, or other digital input devices for permanent storage or analysis.

The digitizer is an extremely wideband instrument whose 1 nanosecond resetime permits it to resolve even the most rapidly changing portions of fast waveforms. Nineteen calibrated time ranges extend from 20 nanoseconds (1 nanosecond or less sample spacing) to 20 milliseconds. Each sample is digitized to a precision of 0.4% of full scale over a dynamic range of 1 volt into 50 ohms.

16 mm. Microfilm Reader

A new low cost, big screen reader for 16 mm roll microfilm has been announced.

The new microfilm reader has a large 16 × 16-inch non-glare viewing screen in a neutral gray color. The special material of the screen transmits a brilliant, un-



distorted image with complete clarity and none of the sparkling effects produced by ordinary glass screens. The reader provides magnification of 27×.

The unit is designed for 16 mm film in 100-foot spools and/or in film magazines or cartridges. It has a precision designed film gate that prevents scratching of valuable film. Variable speed controls permit fast scanning for quick image reference in either forward or reverse directions. At high speed, 100 feet of film moves through the reader in from 15 to 20 seconds. Its path is a straight line without loops or bends, assuring maximum protection for the film.

A New Reverse Osmosis System

by J. B. Wright
Heat Transfer Division
Westinghouse Electric Corporation
Lester, Pennsylvania

The Westinghouse Research Laboratories and Product Transition Laboratory have developed a new family of modified reverse osmosis cellulose membranes with better performance than those now available, and a unique membrane support system offering new applications for purifying water, fractionating process fluids, and controling pollution.

Advancing industrial technology and population growth are accelerating the demand for pure water to sustain life and receive waste materials. Waste materials are usually fed to water streams which become increasingly contaminated with soluble and insoluble discharges and often resist conventional methods of purification.

The growing demand for pure water has led to the development of new tools for repurifying existing water supplies. One of these new tools is reverse osmosis.

Osmosis is the natural process by which plant life transmits freshwater into the plant itself. Freshwater "permeates" or flows through a semipermeable membrane into the more saline plant-sap system. The process continues until the pressure on the "sap" side reaches the osmotic equilibrium pressure of the "sap" solution.

The osmotic process can be reversed by raising the pressure on the "sap" side above the osmotic equilibrium pressure causing the freshwater to be forced out of the sap solution and back through the semipermeable membrane. This forms the basis of a reverse osmosis water treatment system.

Reverse osmosis has the specific capability of separating water (and some other solvents) from certain contaminants such as dissolved solids, colloidal suspensions, suspended (undissolved) solids, as well as bacteria, viruses, and other organic materials. The reverse osmosis membrane can be thought of as a molecular sieve, since it allows the lower molecular weight solvent (water) to pass through while holding back most of the larger molecular weight dissolved and undissolved materials. As molecular weights increase as in organic compounds, the rejection of these larger molecules approaches 100 percent.

While reverse osmosis has been a known phenomenon for many years, only in the past decade has it become economically practical. Certain formulations of cellulose acetate membranes for reverse osmosis systems can produce high-solvent flow-through (flux) while maintaining a good rejection rate of impurities including dissolved solids, colloidal suspensions, and undissolved materials. Recent improvements have also lengthened membrane life.

Better Performance and Longer Life—Key Features of the Westinghouse Membrane and Support Systems

A tubular-design membrane system was selected for the Westinghous system after extensive parmetric studies of alternate configurations were performed. The tubular design maximizes the efficiency of the brine flow control and minimizes clogging, yielding more reliable performance and less downtime for membrane cleaning than with other designs.

The Westinghouse tubular sand module was designed to be rugged and suitable for permanent installation in an industrial environment with little or no required maintenance. The module is a steel-clad, solid element with no clamps, screws or mechanical parts. The critical membrane end seal is achieved by a chemical rather than mechanical closure.

The basic 4-inch by 4-foot module can be arranged in parallel or series flow or a combination of series and parallel flow to satisfy any hydraulic configuration necessary for maintaining good brine velocity within the tubes, **Figure** 1. Module arrangements can be made to suit any plant requirements for 200 gallons per day and up.

Several features make the new Westinghouse system unique in reverse osmosis technology. The new membrane has demonstrated performance efficiency better than twice the industry standard. Also, the membrane support system is a high-strength, resin-bonded sand core which has high permeability for low product-side pressure drop, is inert and durable.

The size and weight of the tubular membrane and its resin-bonded sand support system are somewhat greater than those of other configurations such as hollow-fine fiber and spiral wound. However, the Westinghouse system is stronger and provides better performance and longer life with fewer operating handicaps to the user.

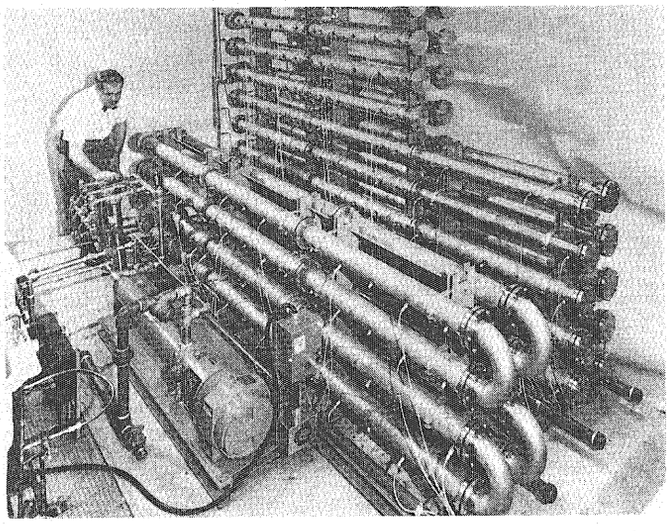


Figure 1—The new Westinghouse reverse osmosis system is a tubular module configuration which can be assembled, mounted and piped together in any number and arrangement to meet the performance requirements for a particular application. This 10,000-gpd unit includes membrane modules, feed pump, mounting frame, piping, back pressure valve, product water collection system and instrumentation.

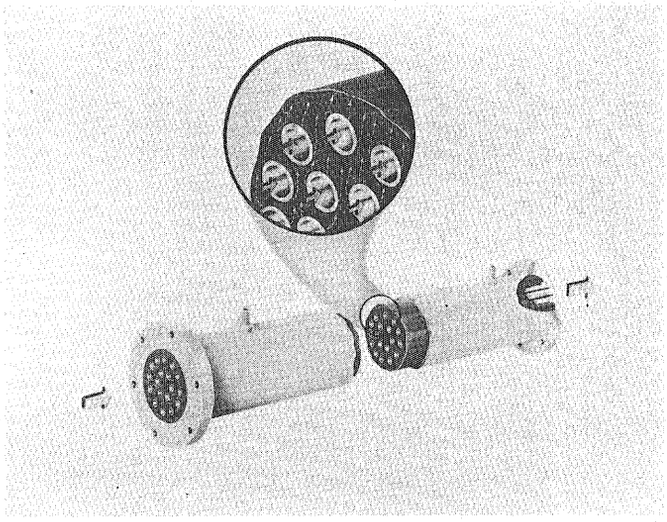


Figure 2—Diagram of a simple reverse osmosis brackish water treatment system using a semipermeable membrane. Hydraulic pressure applied to the brine side forces water through the membrane to the product side leaving the major amount of dissolved solids and all undissolved solids behind. This pressure is great enough to reverse the natural osmotic flow of water from the product side to the brine side, thus the name "reverse osmosis."

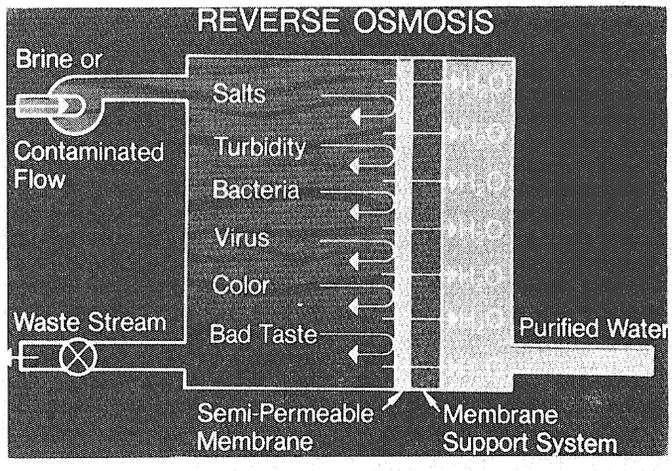


Figure 3—Schematic diagram of the new reverse osmosis brackish water treatment system now available from the Westinghouse Heat Transfer Division.

System Design and Operation

A simple reverse osmosis system is shown in **Figure 2.** Brine (water contaminated by dissolved solids and undissolved materials) is introduced against a semipermeable membrane. The system pressure is increased until it exceeds the natural osmotic pressure of the brine solution. At this point, the solvent (or water) begins to flow through the membrane, allowing very little salt to pass through. If the pressure is further raised, water flow will increase in almost direct proportion.

Figure 3 shows how brackish water flows in reverse osmosis through the treatment system.

Figure 4 shows how increases in pressure and feedwater concentration at 1000 and 4000 ppm (parts per million) affect flux for three variations of the Westing-

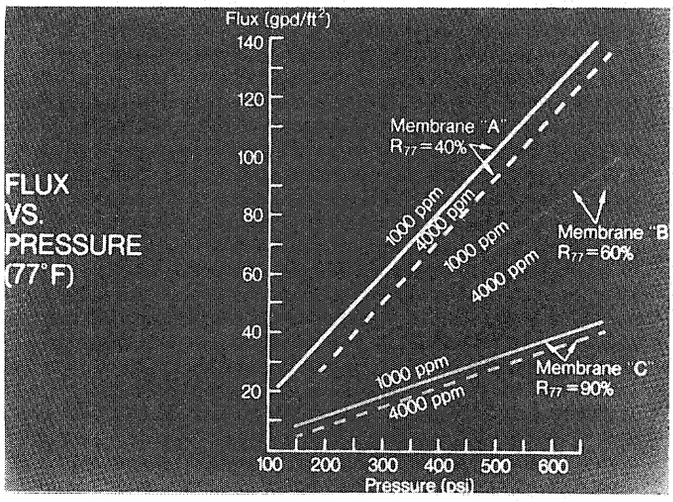


Figure 4—Flux versus pressure curves at 1000 and 4000 ppm brine concentrations for three variations of the Westinghouse reverse osmosis membrane.

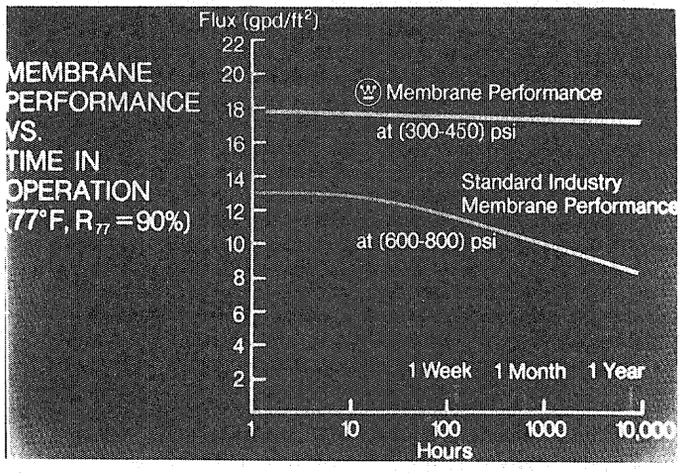


Figure 6—The new Westinghouse system is operated at or below 450 psi since there is no detectable effect of pressure on membrane performance life. The typical cellulose acetate system operates between 600 and 800 psi.

house reverse osmosis membrane. An increase in feedwater concentration will tend to reduce flux. **Figure 5** shows how rejection rates for the three membranes vary

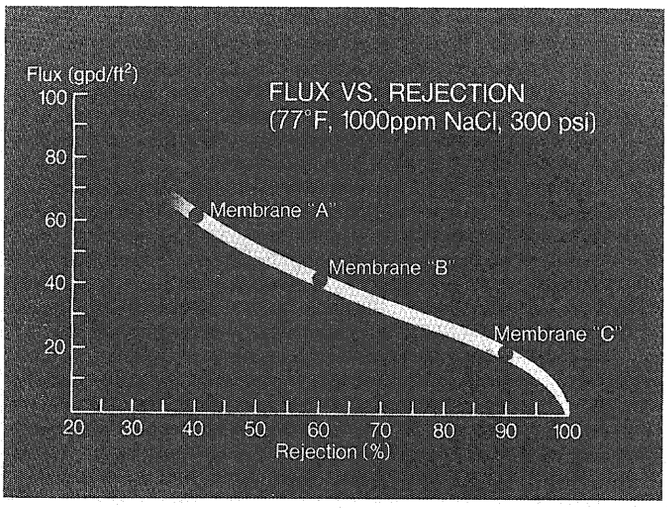


Figure 5—Flux and rejection rates are represented for the three membranes at 77 degrees F, 1000 ppm NaCl feedwater and 300 psi.

with flux at 77 degrees F, 1000 ppm NaCl feedwater and 300 psi.

If pressure and water flow increases are allowed to continue, permanent physical deformation or "compaction" of the membrane will occur. The compaction phenomenon for cellulose acetate memberanes has a detectable threshold at some pressure above 450 to 500 psi and becomes cumulatively worse with increases in pressure. Below 450 psi there is no detectable effect of pressure on membrane performance life. **Figure 6.** For this reason, the Westinghouse system is operated at or below 450 psi.

The Westinghouse system delivers the same volume of product water per square foot of membrane as existing membrane types while operating at one-half the driving pressure. The typical cellulose acetate system operates between 600 and 800 psi to deliver 20 gallons of product water per day per square foot of membrane. The Westinghouse membrane delivers the same flux at 300 to 450 psi. Operating at this low pressure has several advantages including longer membrane life, lower power consumption, lower pump, valve and gasketing maintenance and quick and easy cleaning.

Since the membrane permits essentially desalted water to flow through, there is a natural tendency for a concentration of the brine salts to form adjacent to the membrane surface. This is called "concentration polarization," a key factor influencing membrane performance. It has the effect of raising the osmotic pressure of the brine on the membrane and increasing the driving force needed to effect water extraction through the membrane. Minimizing concentration polarization by promoting turbulence in the flow stream causes a constant, thorough mixing of the entire flow and enhances membrane efficiency. Turbulent flow insures that the membrane sees only the average salinity of the stream. This flow is easily maintained in the tubular configuration reducing performance loss from concentration polarization.

In some solutions, concentration polarization can cause premature precipitation of dissolved solids when operating near the solubility limits of these salts. Precipitates like carbonates and sulphates can cause serious decay in flux and, therefore, increase system downtime for cleaning or, in some cases, membrane replacement if cleaning cannot be easily completed.

Another unique feature of the new system is the resin-bonded sand core which supports the membrane, **Figure 7.** Fiber glass tubing is the most widely used support material in other existing systems. Investigations of fiiber glass show that long-term pressure-creep can lead to membrane stresses beyond acceptable limits and bursting failure of the support tube. These investigations have also shown membranes to have close deformation tolerances within which they should be retained for maximum life.

Its rigidity and long-term strength makes the resin-bonded sand core natural for a reverse osmosis system. The permeability of resin-bonded sand support core is

superior to that of fiber glass. Optimization studies of resins and sand grain size and shape have led to the strength and permeability charactristics now in use.

The permeability of the sand support system is important to system efficiency. Any back pressure placed on the membrane by the support system represents a driving force pressure drop and system energy loss similar to that of the concentration polarization.

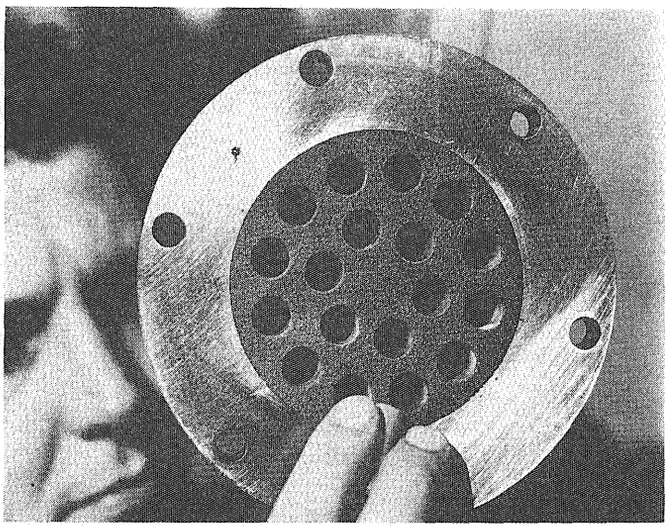


Figure 7—A unique Westinghouse-developed resin-bonded sand core has long-term strength and durability with permeability superior to commonly used fiber glass. The unique Westinghouse membrane is integrally cast on the core.

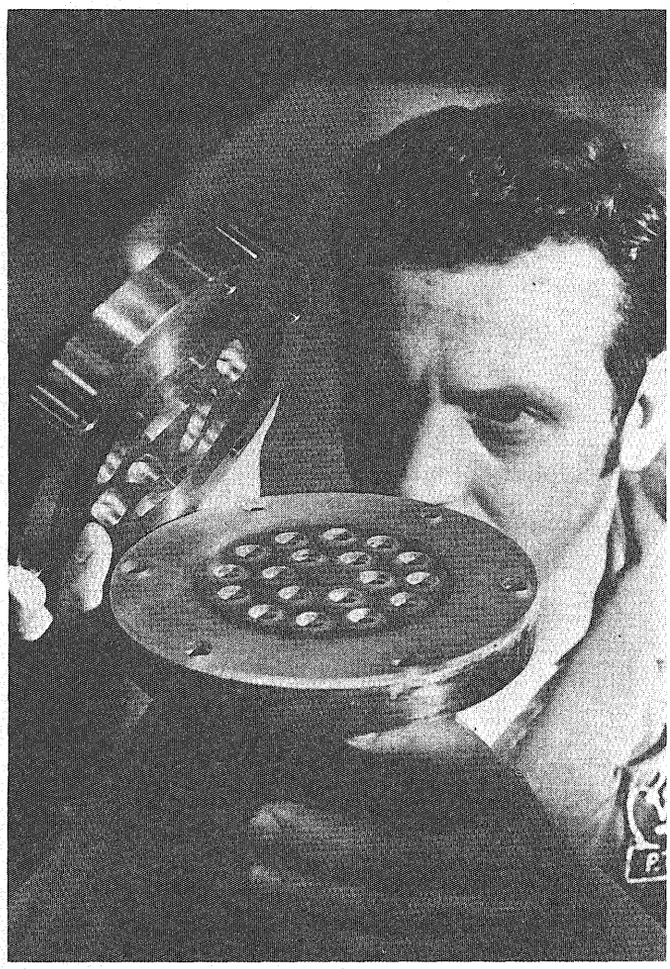


Figure 8—A chemically bonded membrane seal bonds membrane tubes to the sand core end surface, providing a positive closure without the use of mechanical devices.

The sand core support system allows greater control of membrane wall thickness since the dimensional tolerances of the sand core bore holes are closely controlled. This is especially important where the membrane is drop-cast directly on the sand, as in the Westinghouse system.

Membranes which are drop-cast also have superior performance characteristics because a portion of the membrane solution soaks into the sand during the casting process and is securely attached when cured. It is never subejcted to stretching or pinching as when membranes are inserted or glued in place.

Sealing the membrane to prevent passage of feed brine into the product side is important to successful operation. In the past, a mechanical transition or seal has been the practice. Such seals are subject to tolerance variations in manufacture which make this approach more expensive as well as a potential source of leaks. Moreover, many of the solutions which come in contact with the membrane are corosive, so a minimum of mechanical closure devices is desirable. For these reasons, a chemically bonded membrane seal, **Figure 8**, was developed which bonds the membrane tubes to the sand core end surafce, providing a positive closure.

Applications

Tubular reverse osmosis configuration with a resin-bonded sand core support system offers a variety of fluids separation and fractionation applications. In addition to brackish water desalting, the tubular design is well suited for purifying and separating industrial waste water. Detergents and other organic soluble materials such as dyes from the waste water can be returned to the process cycle or concentrated for more economic disposal. Organic solubles can often be separated from the flow streams and concentrated to economically attractive levels while the product water is reduced in BOD (Biological Oxygen Demand) content sufficient for disposal into conventional sewage systems. The range of fluid viscosities and the degree of suspended solids which can be tolerated in the tubular design is also much greater than that of the hollow-fine fiber and spiral-wound configurations.

Reverse osmosis will supplement rather than displace conventional fluid treatment or separation systems. There are fluids unsuited to reverse osmosis treatment such as those with very high pH factor. At pH above 9, a cellulose acetate membrane will hydrolyze and dissolve in a matter of hours and thereby lose its ability to reject dissolved solids. Higher temperature fluids above 100 degrees F may also shorten membrane life. Certain elements such as soluble iron, if allowed to precipitate on its surface, will clog the membrane until redissolved out again. Abrasive materials can also permanently damage the membrane and should not be allowed to impinge against it.

Typical Estimated Water Costs For Brackish Water Treatment

A hypothetical 10,000-gallon per day Westinghouse reverse osmosis unit has an amortization rate of 15 percent with membrane replacement required every two years.

Power cost is 10 mils per kWh with operating and maintenance labor costs approximately $5 per manhour. About 3 hours per week is required for maintenance. Unit availability is 95 percent or about 345 days per year with a recovery rate of 50 percent (50 percent of the feedwater is converted to product water). Using these parameters, Table I lists the annual costs of such a unit. Total water cost is $2.18 per thousand gallons.

TABLE I
ANNUAL COSTS

Capital at 15% of $24,500	$3,675
Membrane replacement	2,620
Power 7½ hp at 10 mils	465
Labor 156 hr x $5.00/hr	780
	$7,540

Product water produced per year
—10,000 x 345 = 3,450,000 gal.
Water cost = $7,540
3,450 K gal = $2.18 per K gallon

Successful Testing Program Confirms Module Design

Field tests have confirmed the soundness of the Westinghouse 4-inch by 4-foot modular design. A field testing program has been underway since early 1970 preceded by 170,000-module hours of laboratory testing using various water types and contaminated fluids. A standard module was installed in a compact cabinet, **Figure 9,** with the necessary pump, gages and controls to permit simple connections in the field to any water source and requiring minimum attention during the test period. To simplify test procedures, each field unit was equipped with a built-in, automatic product-side sampling valve, timed to open for one-minute periods to obtain module flux data. Sample bottles of the feed, the product and the blowdown were analyzed once per week.

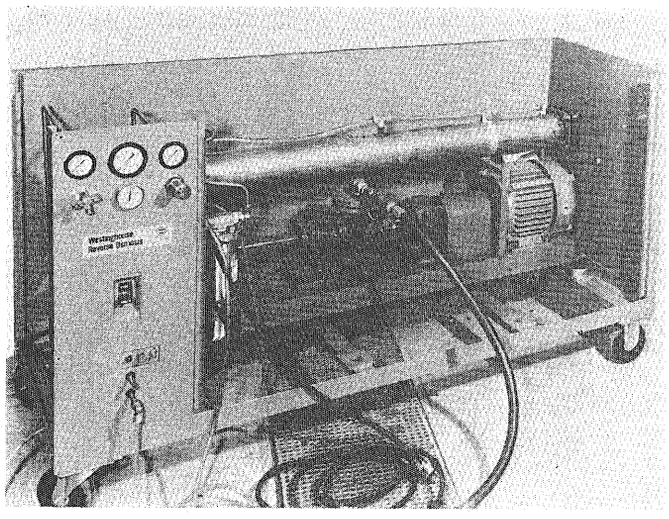


Figure 9—A 150,000-hour field testing program preceded by 170,000 hours of laboratory testing using field test modules mounted in a compact cabinet have confirmed the soundness of the Westinghouse design. Modules were equipped with pump, gages and controls permitting simple connections to any water source.

The first test unit was installed at the Westinghouse Heat Transfer Division, Lester, Pa. Tap water was used as feed for the first 2500 hours of operation. During this time, a 25-micron filter was used to separate particulate matter from the feed. The unit performed as expected rendering 18 gallons per square foot per day with a total dissolved solids rejection rate of 94 percent.

Following its initial testing period, the unit was connected to the Lester plant cooling and sanitary flush water drawn directly from the Delaware River using only a coarse sand initial filtration with no biological treatment. Within hours the 25-micron filter clogged enough to collapse. Larger 50-micron filters were installed with the same result.

The unit was then operated without the filter cartridge to determine the potential effects of more rapid clogging of the membrane from greater amounts of suspended solids in the feedwater, and to study methods of membrane cleaning. The amount of suspended material found in the raw Delaware River water caused more rapid fouling and clogging of the membrane. In about ten days, the flux had dropped to about 60 percent of the clean flux rate. However, it was found that the membrane surface could be easily and quickly cleaned in a few hours with a mild soak-flush of detergent.

The raw Delaware River feedwater contained more than 60,000 E. Coli bacteria per 100 cc. The rejection of this pathogenic bacteria was above 99.99 percent and the bacteria showed no harmful effect on the membrane.

The unit was operated successfully for approximately 2500 hours using the periodic soak-flush method for cleaning as needed.

Other similar field test units have been in continuous operation using a variety of brackish waters including Schuylkill River water (near Philadelphia) and process fluids such as industrial cleaning waste water with high detergent content. All have demonstrated similar results. There have been no mechanical failures to date in any of the modules and membrane performance has been consistently restored by the simple cleaning procedure of soak-flushing with detergents.

In cases where iron deposit fouling occurred, brief rinses with hydrochloric acid were effective in dissolving out the iron and restoring membrane performance.

This field testing proved that the Westinghouse tubular reverse osmosis system can operate effectively without prior filtration of the feedwater. Where frequent changing of the filter cartridge is required, filter maintenance is expensive. In some cases, filtration costs alone can approach the cost of an entire reverse osmosis system.

In some cases, the feedwater has a pH factor above 7 to 8. A small volume of acid will bring the pH below this range for longer membrane life and better performance.

Conclusion

The new Westinghouse reverse osmosis system adds a new dimension to the technology of fluids separation, concentration of fluids, and fractionation of fluid constituents. Reverse osmosis will offer new opportunities to attack existing and growing pollution problems. A promising future development now in research study is the direct recovery of primary sewage effluent, raising it to the potable water from the ocean is another promising new area.

LOG'S LOG

by Ace & Zeus

INTRODUCTION: With all the subtlety of a herd of elephants in an echo chamber (wearing bumper tennis shoes of course), E-Day has come and gone. Somehow we have to wonder if it was the real thing or not. I mean, what's a coronation without a little flour to lighten (or was that whiten) things up a bit; or the good old days when E-Day got cancelled altogether. (Thanks to all those hippie, commie, pinko, radical freaks!) Blimey!

Lush's Corner

As a token remembrance of the Expeditionary Force, Bruce decided to create the world's only drinkable twenty-one gun salute. After turning a few wheels and chewing on his rubber chicken, the old B. produced "Bruce's Navy" (it puts you up the creek without a paddle).

Procedure: Put 1½ oz. of your favorite whiskey spirits (whether it be Irish, Scotch, Canadian, Kentuckian, or Indian) into the plastic glass (that sounds redundant but . . .) you got from the last river-banking expedition. Then you pour in twice as much ice as you can fit in your mouth at once, add a handful of lime juice, and as much sugar as it takes to make it—drinkable.

This is unconditionally guaranteed to make everybody happy (if taken in excess) except the Queen. (Was that ee or ea?) Bruce, who likes to keep on top of such things, decrees a final toast: "To the Queen!"

Curses

Since this is the last Log's Log that the E-Force will write, Zeus and I decided to reveal the secret of the Curse of The Crazy Kahoona's Kazzooies. To make it brief (we've got to make something) this curse causes the editors of Log's Log to fail hopelessly in any attempt to hold (in any way) a member of the opposite sex (or any part thereof). Zeus and I were warned of this last fall by the Crazy Kahoona in the ME basement. We laughed —but not for long.

Yours truly, Ace, was the first to fall. Lisa, a chick I had been working on (Ha! Ha!) for five years with a fair amount of luck (?) suddenly became engaged to a real zero she'd only known for less than a month. (To make matters worse, I was unknowingly conned into taking her to the drugstore to get her—I should say their—prescription.) Way to go, ACE! Other ace-outs since Lisa were: Sue, Mary, Diane, Linda, Kristi, Eileen, Chris, Norma, Pam, Jane, and Sally.

Zeus is having problems, too. Since he started writing Log's Log with this Ace he's been burned by Jean, Betty, Mary, and Marta. His story is similar, but with a few minor differences. Things seem to go well at first, but suddenly turn third-rate. Another interesting fact is that when either one of us has the other one hasn't.

There is nothing we can do now except to warn the poor devils who follow in our shoes (our feet have green gangrene as a result of the murk). Whoever it is had better stock up over the summer (keep a spare in your glove compartment, too).

So with our spirits hanging at the level of our kazzooies (i.e. low), Ace and Zeus trudge out of the murk and into the future. Both of us should be decorated with the Black-and-Blue Heart (similar to the Purple Heart) for wounds incurred while in battle. Oh well, Zeus, pass the Ancient Ancient Age, will ya . . . but I'll settle for Karen.

Ace's Advice of the Month

This month Ace's advice becomes Ace's complaint—hopefully which will be resolved by next fall. My monthly advice is being written this month while sitting in a very aesthetic setting—a statistics class taught by a GDI (alias camel jock). Any fears I had of not producing enough material for Log's Log were quickly quelled by this honorable herder of the humps. Between busily trying to find the probability of finding an oasis in the Sahara desert (given that camels having three humps and porkers bring home the bacon are mutually exclusive events) and selecting ten black beads from a sample of four red beads, this jock-ace manages to utterly annihilate the English language. Another of his outstanding features is that he can make the letters h, s, r, t, u, and v all look like the letter x. In this way, the student can take his choice of which letter he prefers. (It does wonders for note-taking.) If his fast writing doesn't confuse you, his fast talking will.

To make matters worse, our dear "Salamat swinger" has two able-bodied back-up ace-istants—Wing Nut and Fung Gus. Remember the Chinese water torture? Well, it's been revised and improved a bit to the Chinese T.A. torture. The only difference is that with the latter you die a slower and more painful death. (Ah-so!)

Now some people say I'm biased, but this is ridiculous because it's a known fact that most people have just one. Our bouncer from the Log Office, The Big Goosh, summed it up well when he said, "Biased? Hell, no. I hate 'em all the same!"

CONCLUSION: Since this is our farewell performance, Ace and I would like to declare a tie for the coveted Flying Fickle Pickle Plaque, given to the group that has done the most to make our job a little more miserable. The winners are: Plant Services, Camel Jocks Anonymous, and Wong's Chinese laundry and fortune cookie factory bowling team.

We would also like to thank Bruce (of B's B. & B.S.) for letting us give him all that free publicity—that is until he gets our bill, and Gunge Gazette for filling in for the Concordian. Lastly, without being leastly, the famous Expeditionary Force of Ace and Zeus would like to thank you, our personal audience, for laughing at yourselves along with us. So may you have blue skies and green lights, live it up, and sleep in the streets—and may all your profs next quarter speak English!

Splinters

—vilitas et crudas semper eternam
by BARRY JOHANSEN and RALPH POLKINGHORNE

Bedtime suggestion: "That was a great little party we went to tonight. . . . what say we end it up with a bang?"

• • •

Anyone can play bridge, but it takes a canibal to throw up a hand.

• • •

Then there was the freshman E.E. who was sent to the stockroom to get a Fallopian tube.

• • •

Definition of a smart girl: one who can play post-office all night without getting any mail in her box.

• • •

Confucius also has said: Man who have hole in pocket feel cocky all day.

• • •

A fox is a guy who always gets what the wolf is after.

• • •

Three turtles decided to have a cup of coffee. Just as they went into the cafe it started to rain, so the biggest turtle said to the smallest turtle, "Go home and get the umbrella."

The little one said, "I will if you don't drink my coffee."

"We won't," promised the other two.

Two years later the big turtle said to the middle turtle, "Well, I guess he isn't coming back, so we might as well drink his coffee."

Just then, a little voice called from just outside the door, "If you do, I won't go!"

The doctor had just completed his examination of the teenage girl:

"Madam," he said to her mother, "I'm afraid your daughter has syphilis."

"Oh, dear," exclaimed the embarrassed mother, "Tell me, Doctor, could she have possibly caught it in a public lavatory?"

"It's possible," replied the physician after a moment, "but it would certainly be uncomfortable."

• • •

Some of us would gladly trade the cold war for a hot peace.

• • •

Eskimo venereal disease caused by rubbing roses: Sniffilis.

An inmate at the insane asylum was being examined for possible release. The first question the examining doctor asked was: "What are you going to do when you leave this institution?"

"I'm gonna get me a slingshot," said the patient, "and I'm gonna come back here and break every goddam window in the place."

After six more months of treatment, the patient was again brought before the examining doctor for possible dismissal, and the same question was put to him.

"Well, I'm going to get a job," the patient replied.

"Fine," said the doctor. "Then what?"

"I'm going to rent an apartment."

"Very good."

"Then I'm going to meet a beautiful girl."

"Excellent."

"I'm going to take the beautiful girl up to my apartment and I'm going to pull up her skirt."

"Normal, perfectly normal."

"Then I 'm gonna steal her garter, make a slingshot out of it, and come back here and break every goddam window in this place!"

SPLINTERS cont.

Slowly with eyes softly glowing, the beautiful debutante raised a glass on high, exulting "Port wine to me is the nectar of the gods, the elixir of life. When I imbibe its fluid my soul begins to throb and glow. The music of a thousand muted violins whispers in my ear, and I am transferred to the make-believe world of magic. On the other hand, beer makes me barf."

• • •

"Hey, did 'ya see her?" exclaimed a ME, "she looks like a million dollars!"
To which the EE replied, "And she's just as hard to make."

• • •

Note: The humor editors of the 'Log would like to thank the other Engineering mags who have been running our jokes. Imitation is the highest form of flattery.

• • •

After a good run down a slope, a friend of ours was heard to exclaim: "That's got to be the most pleasurable thing that man can do!"
To which a passing ski-patrol replied, "The second most pleasurable thing."

• • •

Upon seeing a little girl lead a cow along a country road, the parish minister stopped her and asked her, "Little girl, where are you taking the cow?"
"To the bull," replied the young lassie.
"Can't your father do it?" questioned the clergyman.
"Nope," answered the little girl, "only the bull."

• • •

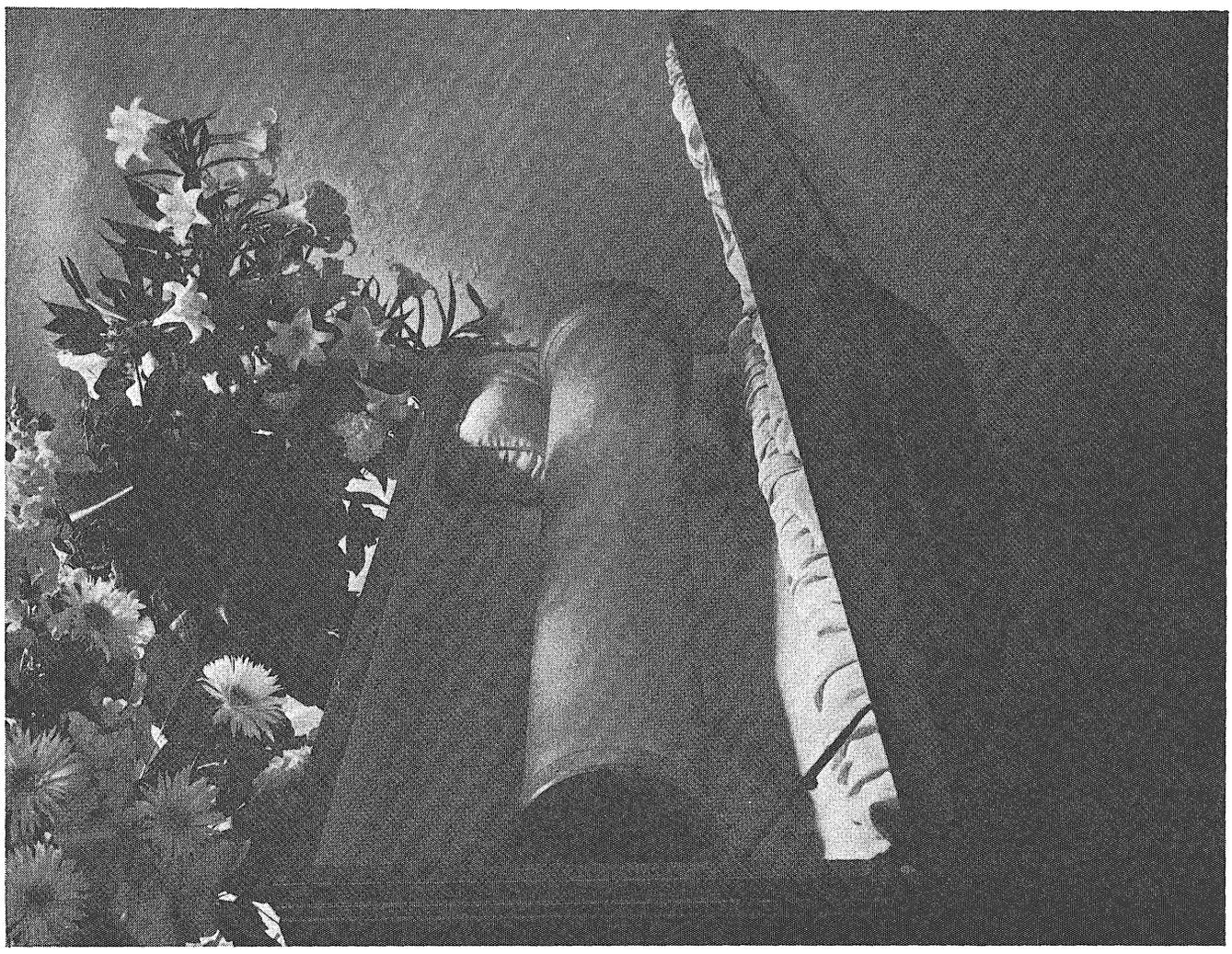
And then there was the porcupine who bent his quills, trying to overpower a wire brush in the corner.

• • •

Studying at the library on Friday evening is like dining at Coffman. You force yourself to digest but you wish you were eating out.

• • •

Another note from Paris, our local gourmet, fashion editor, and resident pervert: When preparing a dish for bedtime, champagne makes a good tenderizer.

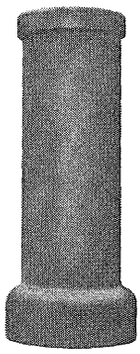


Clay is dead. Long live clay pipe.

Clay makes the longest lasting pipe in the world. And all because of one important physical property: chemically speaking, it's dead.

Clay has no stored energy so it's virtually indestructible. Other substances tend to expend their stored energy until they're chemically at rest. And, as any material gives off energy, it breaks down chemically.

Since clay is already at rest, there's practically nothing that can corrode it or weaken it. So you can find clay waste systems all over the country that have been going generation after generation without significant wear or corrosion.



And you can get a 100 year guarantee*on clay pipe from Dickey Clay while makers of other kinds of pipe never seem to guarantee their product for **any** definite length of time. Best of all, Dickey has added to the natural wonders of clay pipe with a patented urethane joint. One that keeps the entire wastewater system bottle tight even under the most extreme conditions, for the life of the system.

We don't mind telling you that clay pipe costs a little more than other kinds. We don't mind because the cost of pipe is only a small fraction of the cost of a wastewater system . . . and the additional cost of clay pipe is so small that the effect on the total cost of the system is minimal. Yet that minimal extra gives you the only kind of system you can depend upon to be permanent.

When you want to be sure, specify Dickey Clay pipe. Your waste disposal system will rest in peace.

W.S. DICKEY *Clay Manufacturing Company*

Kansas City, Missouri; St. Louis, Missouri; Lehigh, Iowa; San Antonio, Texas; Birmingham, Alabama; Meridian, Mississippi; Texarkana, Texas-Arkansas

*Dickey Clay will supply—free of charge—replacements for any clay pipe which has been damaged, destroyed or impaired in service for a period of 100 years from contract date, if damage has been caused by corrosion or other chemical decomposition from acids, alkalis, sewage or industrial wastes (except Hydrofluoric Acid) or damage by rats or other rodents whether pipe is used for industrial, residential or general drainage purposes. Damage from improper handling, placement or trench loading is not covered.

Even if you don't like the air you breathe, you can't stop breathing.

When was the last time you went out for a breath of fresh air and got it? How long has it been since the sky looked really blue?

Every day, our cities dump hundreds of thousands of tons of waste into the air. Carbon monoxide. Sulfur dioxide. Fluoride compounds. And plain old soot.

If something isn't done about air pollution in your lifetime, it may cut your lifetime short.

Air pollution can be controlled. The key is technology. Technology and the engineers who can make it work.

Engineers at General Electric are working on the problem from several directions.

Rapid transit is one. In many cities, the automobile causes more than half the air pollution. In some cities, as much as 90%. But engineers at GE are designing new equipment for rapid-transit systems, encouraging more people to leave their cars in the garage.

Another direction is nuclear power. General Electric's engineers designed the very first nuclear power plant ever licensed. A nuclear plant produces electricity without producing smoke. And as the need for new power plants continues to grow, that will make a big difference.

There are other ways General Electric is fighting air pollution. Maybe you'd like to help. We could use your help. But don't expect to come up with an overnight solution to the problem.

The solution will take a lot of people, a lot of talent and a lot of time. You'll breathe easier—once you get started.

GENERAL ELECTRIC

An equal opportunity employer