LIBRARIES
UNIVERSITY OF WISCONSIN–MADISON

Wisconsin engineer. Volume 78, Number 3 December 1973

Madison, Wisconsin: Wisconsin Engineering Journal Association, [s.d.]

https://digital.library.wisc.edu/1711.dl/7P3DBZ6M5SIJV8I

http://rightsstatements.org/vocab/InC/1.0/

The libraries provide public access to a wide range of material, including online exhibits, digitized collections, archival finding aids, our catalog, online articles, and a growing range of materials in many media.

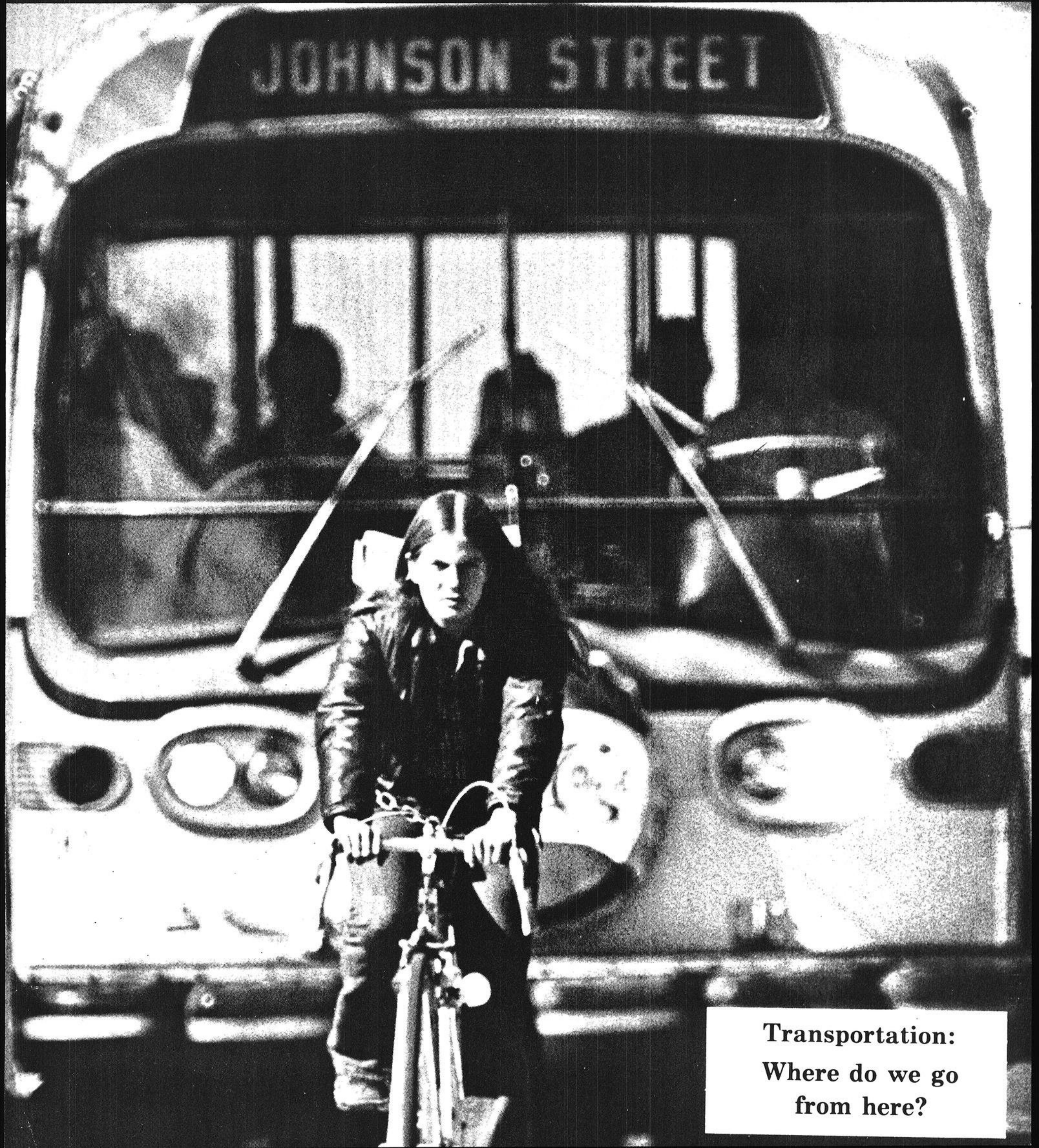
When possible, we provide rights information in catalog records, finding aids, and other metadata that accompanies collections or items. However, it is always the user's obligation to evaluate copyright and rights issues in light of their own use.

728 State Street | Madison, Wisconsin 53706 | library.wisc.edu

VOLUME 78, NUMBER 3

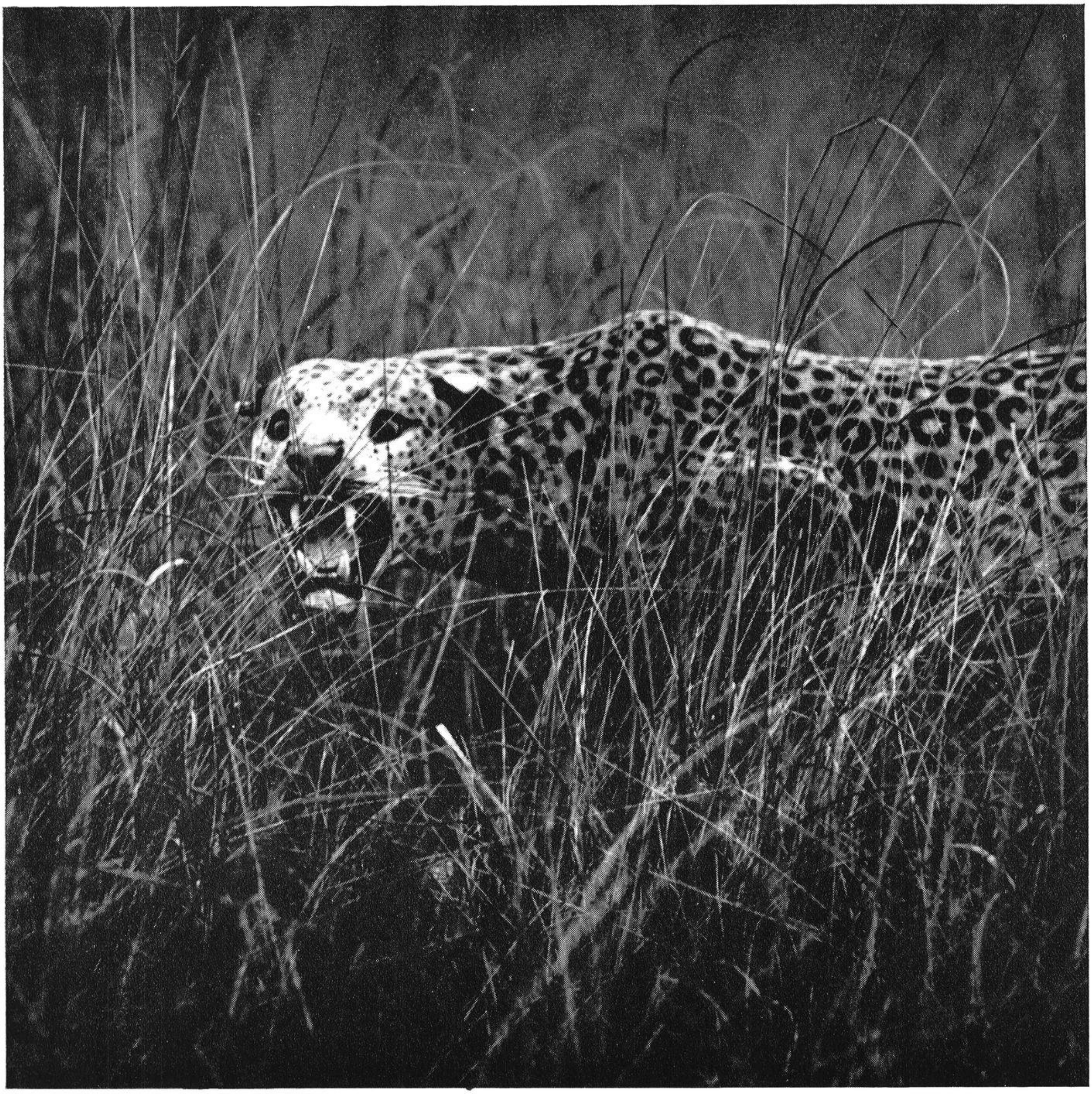
35 CENTS NOVEMBER, 1973

wisconsin engineer



Transportation: Where do we go from here?

Come closer. It's only a modacrylic.



The leopard was made by a taxidermist. Its coat is a modacrylic textile fiber made by Union Carbide from several basic chemicals. It's called Dynel.

Of course, man-made fibers aren't new. But for versatility, Dynel probably has no equal. We can make it as soft and warm as fur for your coat. Or so tough it approaches the strength of steel.

You'll find it in blankets, work clothes, automobile upholstery, toys, jewelry. In carpets, towels, drapes, paint rollers.

And since Dynel is chemical-resistant, durable and virtually nonflammable, it's used in many more ways. On laminated decks of boats. For tents. As overlays for storage tanks and air ducts.

But regardless of all its practical uses, Dynel is most famous for something else. It's great for making wigs. For blondes and brunettes and redheads.

Remarkable fiber? We think so. But haven't you found that a lot of remarkable things come from Union Carbide?

UNION CARBIDE

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

An equal opportunity employer.

"... the wise man looks into space, and does not regard the small as too little, nor the great as too big, for he knows that there is no limit to dimensions"

Lao-Tse

wisconsin engineer

Published by the engineering students of the University of Wisconsin.

STAFF

Brad Bennett ...... Co-editor
Bruce Haas .... Co-editor
Don Johnson Associate Editor
Harry Diament .. Photo Editor
Laura Jeffery ... Photographer
A. Reid Fitzner .... Artist
Rick Giesler .... Staff
Mark Holler .... Staff
Peter Scheer .... Staff
Jeff Kratz .... Staff
Judy Endejan .... Staff

BUSINESS STAFF

Bob Hubinger ...... Business Manager
Tom Burtard ..... Distribution
Dan Seidl .... Circulation
Tom Seidl .... Staff

STUDENT ADVISORS

Stan Crick .... Business
Mary Stein .... Editorial

BOARD OF DIRECTORS

Prof. George R. Sell
Prof. Howard J. Schwebke
Assoc. Prof. C.A. Ramous
Assoc. Prof. Raymond B. Esser
Prof. Wayne K. Neill
Prof. Charles G. Salmon
Asst. to Dean, Mr. Hosman
Asst. Prof. Richard Mill

Cover Photo
Courtesy of Mark Perlstein

TABLE OF CONTENTS

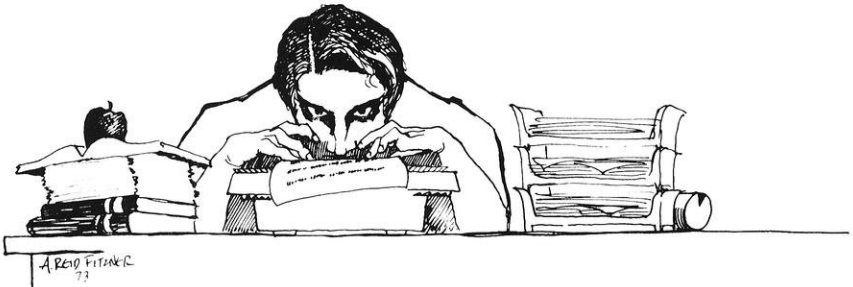
Chairman: DANIEL L. GRIFFEN, JR., Iowa State University, Ames, Iowa.
Publishers Representatives: LITTEL-MURRAY-BARNHILL, INC., 2906 Lincoln Building, 60 East 42nd St., New York, N.Y. 10017.

* * * * * * * * *

Second Class Postage Paid at Madison, Wisconsin, under the Act of March 3, 1879. Acceptance for mailing at a special rate of postage provided for in Section 1103, Act of Oct. 3, 1917, authorized Oct. 21, 1918.

Published monthly from October to May inclusive by the Wisconsin Engineering Journal Assn., Subscriptions: one year—$2.00; two years—$3.75; three years—$5.25; four years—$6.50. Single copies are 35 cents per copy. 276 Mechanical Engineering Bldg., Madison, Wis. 53706. Office Phone (608) 262-3494.

All rights reserved. Reproduction in whole or part without written permission is prohibited. Copyright applied for 1972.



Editorial

Pick a Crisis; Any Crisis

Engineering students and graduates are facing a severe crisis, one that is demanding all of their time, energy, and technical experience. A crisis so immense that it may inundate all of society's creative technological expertise, and drown the scientific capabilities of America. This crisis is a conflict of crises.

The engineer is being bombarded by a variety of individual social problems, each vying for his attention. This conflict is scattering the productive capacities of the engineer, forcing him to divide his talents among the numerous, sundry concerns that have sent a panic-stricken society into pandemonium.

First there is the fuel crisis. Then, of course, there is an energy crisis, a food crisis, a pollution crisis, an extinction crisis, a waste crisis, a transportation crisis, and an inflationary crisis.

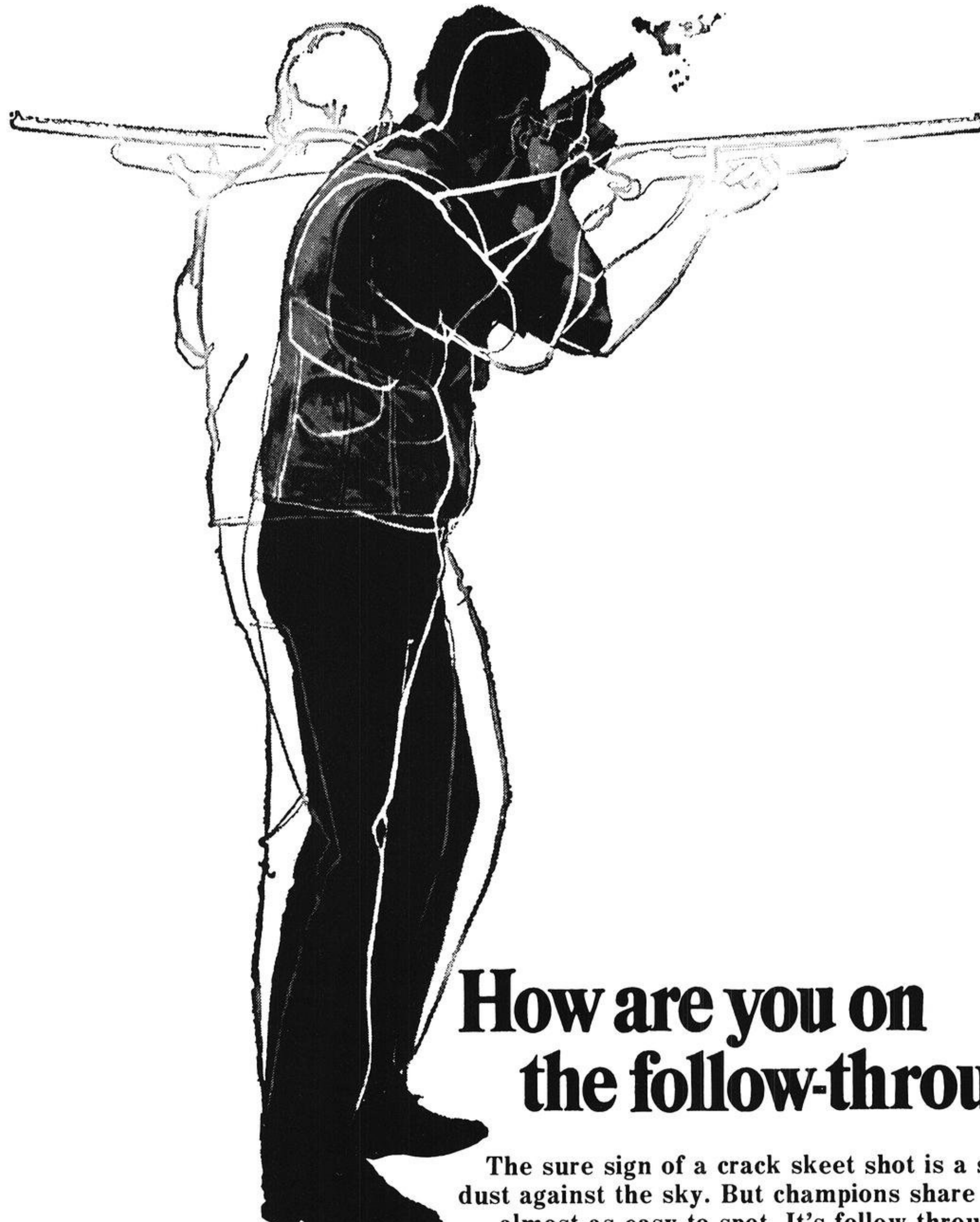
Who can keep up with them? There is a grain shortage, a paper shortage, a gas shortage, a power shortage, a protein shortage — and to top it all off, a shortage of engineers! Americans are becoming so preoccupied with the "horrendous crises of our time," that one would think impending doom is certainly a matter of a couple of months.

Who is the expected savior of society? Why, the engineer, of course. While the energy crisis has become an intensely popular social and political rallying point over the past couple of years, the engineer has for decades been experimenting and developing several methods of alternative fuel consumption and power protection. It is the socio-political complex, however, that has been ignoring the discoveries of the engineer, concluding under mass mania that nuclear power plants will either explode or emit lethal doses of radiation into the environment.

In this issue, we are mentioning a number of alternatives to the so-called "transportation crisis". Numerous developments in both transportation systems and transportation technology have offered plausible solutions to congestion, parking, traffic accidents, and speed. Many of these developments have been proposed for years, and yet federal, state and local municipalities have disregarded them, concerned instead with shifting the existing patterns of congestion, and buttressing themselves against the inevitable.

Why does society refuse to accept the developments of technology? While raising the battle flag of "crisis", it chooses to ignor various solutions. It takes more than a crisis to convince society — it takes a disaster. One can't just shove the problem in its face, one has to ram it down its throat.

The task facing the engineer is to choose from the many areas of concern confronting the nation, and to play the politician. Engineers must be able to convince the populace of the value of their solutions, and to capture the interest of the decision-making bureaucracy, who must solve the crises before they turn into disaster. WE



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 continuing 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).

TIMKEN®

REGISTERED TRADEMARK

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

Practice Aids Problem Solving

(Editors note) Dean Fred O. Leidel wears many hats. Two of these are those of freshman academic Dean and of freshman adviser. For this Dean's page he has chosen to wear the hat of freshman adviser.

Way back when I was in college, the flying career I dreamed of was terminated abruptly by my failure to pass — not the flight tests — but the all - important physical examination. As you might imagine, my immediate disappointment was overwhelming. However, the memory of the fun of trying and the lessons learned from the whole experience make it all worthwhile and pleasant to remember. Let me tell you about it.

Be warned that this is really a lesson on how to write better problem-solving examinations in college, which is one of the lessons I learned from my experience, believe it or not.

I was enrolled in mechanical engineering as preparation for employment as an aeronautical engineer. This is quite appropriate, even today. What I yearned to do, however, was to pilot an airplane, not merely to design and build one. As a consequence of that, more time than I could afford was spent at the Madison Airport, which then existed on a piece of hallowed ground (to me at least), a mere 800 feet wide and two runways 800 feet long between the Oscar Mayer Packing Plant and the Sun Prairie Road, now occupied by a portion of highway 113. I washed airplanes, filled them with gas and oil, pushed them in and out of the hangar, sold tickets for airplane rides, cleaned the hangar and swept the office - anything to be allowed among the pilots. All of this was without pay, except for a nickel commission on each dollar ride ticket that I sold. The effort paid off, I felt, for I became an accepted member of an elite "in" group. I was a frequent freeloading flight passenger, went along on barnstorming trips to sell tickets, and even got "free" ground school and flight lessons. Those were the days of open biplanes, and it was exciting!

It was the physical examination for a student pilot's permit, scheduled shortly after my first solo flight, that was my downfall. I have a wierd pair of eyes that for most normal functions perform well. However, vision from only one eye registers at a time, making normal depth perception a scientific impossibility. Therefore, when as part of the physical examination I was asked to line up the two light colored rods inside a black box, I couldn't tell whether the rods were inside the box or outside the box, to say nothing about whether or not they were side-by-side.

Thus ended my flight career, with less than three hours of solo time. I was heartbroken.

To explain what this experience taught me indirectly about writing problem-type examinations, let me backtrack and explain how I learned to fly (although with only three hours of solo time, I never really did learn).

First I read books on flying. I understood the theory of flight perfectly, but reading those books did not make me a pilot. I listened to the ground school lectures intently, and understood every word of them but this did not enable me to fly. I thought I was flying the airplane throughout the dual flight lessons, but I wasn't really, for the flight instructor was always right there to correct all of my more serious errors. I thought I was really a pilot when I first soloed (and it was an exhilarating experience), but conditions were ideal and the instructor knew it or he would not have dared let me up alone. Although I never got that far, after twenty-five hours of intensive practice, I would have been ready for a private pilot's flight test, which I just might have passed. And that would have been just the beginning!

How does all of this relate to the writing of problem-solving examinations in college courses such as calculus and chemistry and physics? Let me tell you.

You can understand your textbook completely, and not be able to solve problems, just as you can read about flying and not be able to fly. You can understand your lecturer and TA completely and not be able to solve problems, just as ground school can not teach you to fly. You can solve all of your assigned daily problems, with the help of your textbook, your buddies, and your TA, and not be ready for a written examination, just as you can take off, maneuver, and land an airplane with your flight instructor on board and not be ready to solo.

After being able to solve one problem of each type independently, it takes much more independent problem solving experience to assure success in your calculus or physics exam, just as the first solo flight must be followed by hours of solo practice to assure success in the flight test for a private pilot's license. Problem solving skill takes drill, drill, drill.

I was prompted to recall and write this by freshmen who tell me "I understood the subject (meaning the book and the lectures) perfectly, but I couldn't pass the test. I froze up completely." Further discussion with these freshmen usually brings out the lack of independent problem solving drill insufficient quality. Of course, they couldn't pass the test! Understanding the input does not make you ready to solo! It takes practice — practice makes perfect.

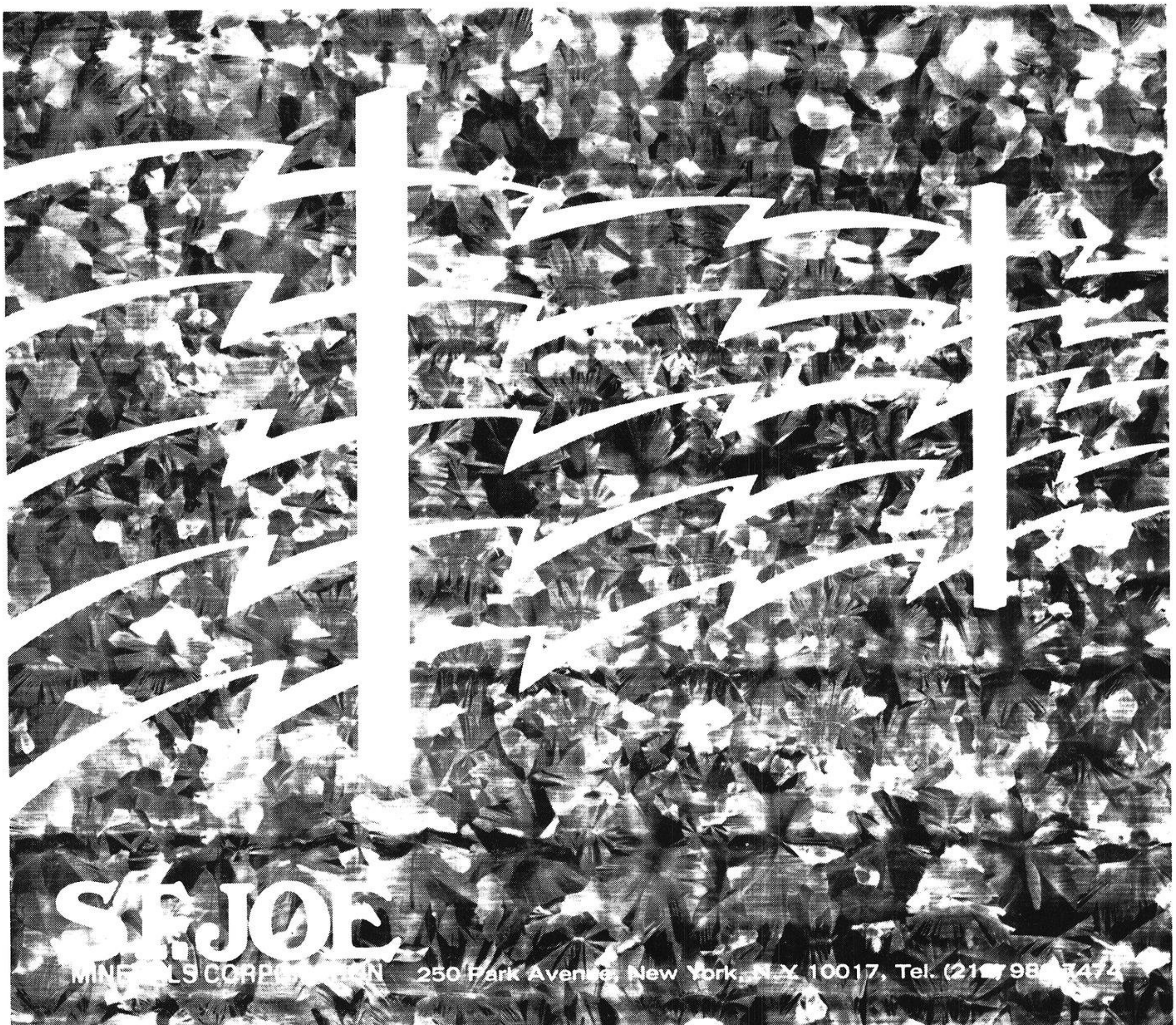
Needless to say, I have told my little corollary before. I hope that it has helped some students to be successful. I hope that it helps you, too. WE

GALVANIZED STEEL has an "ELECTRIC FENCE" to keep corrosion out of your product

The layer of zinc metallurgically bonded to steel in the galvanizing reaction is much more than just a skin deep barrier against rust. ☐ When the tough zinc coating is scratched, gouged or worn through, an electrochemical current fences the gaps and the zinc slowly sacrifices itself as it continues to protect the steel. This happens because, in the galvanic series, zinc is less noble than steel and will corrode sacrificially—fighting a stubborn delaying action against corrosion's attack. ☐ The zinc coating is bonded so firmly and uniformly to the steel that it is practically a part of the base metal and will withstand any deformation that the steel can. Galvanized steel can be formed by virtually any metalworking operation and can be readily joined by welding or soldering. When fabrication involves cutting or drilling, zinc's "electric fence" provides lasting protection to the exposed edges of the steel. ☐ Today, galvanized steel is available in finishes custom-tailored to suit your specific application. ☐ In addition, galvanized steel has the strength, hardness and heat resistance (up to $500^\circ F$) to protect your product's performance.

NO OTHER MATERIAL GIVES YOU THE COMBINATION OF STRENGTH, CORROSION-RESISTANCE AND ECONOMY YOU GET FROM GALVANIZED STEEL.

ZN-520



Driving Away From Immobility

by Judy Endejan
of the Engineer Staff

About the Author

Judy Endejan hails from Milwaukee, Wisconsin. She is currently a junior majoring in Journalism. She is a copy editor and reporter for the Daily Cardinal. She hopes for a career in newspapers or preferably, magazines and is a new *Engineer* staff member.

Ranking right up there with the energy and environmental crisis, is the crisis of transportation. Modern, urbanized man is loathe to relinquish the car as his chief mode of transportation. Consequently, we have congested cities, inadequate streets and highways and a great number of irritated people who complain about the rotten traffic situation.

Man has reached the point where he must either become increasing immobile or else develop some other viable form of transportation for the future.

Fortunately, most communities are choosing the latter alternative. They are developing the means to respond to their transportation needs. Increased use of buses, the resurrection of the train, and policies, such as increasing parking fees to discourage cars from entering downtown areas, are some of the devices used by many communities.

Transit planners forecast use of new technological devices, such as the monorail system, for the future. The Madison-Dane County area, has been progressive with its mass transit, particularly in the area of buses. Madison has increased bus ridership in recent years without raising fares, a unique situation, different from bus services in other communities.

The Madison Metro bus lines are publicly owned and operate at a deficit of $600,000 a year. Fortunately, as of this year, the state will pay up to two-thirds of this deficit. James McLary, Madison's transit co-ordinator, explained the deficit as a necessary evil. "We have taken the attitude that public transit is a service and must be provided," McLary said.

Measures have been adopted to encourage bus ridership, such as Balanced Transportation Week, September 17-23, 1973, in which bus service was provided free in Madison between 9 a.m. and 3 p.m. Monday through Friday.

The week was a huge success, showing a 93.5 percent increase in bus ridership over the entire week. McLary maintained that bus ridership has remained higher than normal after the free week of service.

Results of this free bus week presented the following options to be studied in Madison:

•Reduced fares during off-peak hours.
•Reduced fares all day.
•Increased service.
•Special free service promotion.
•A parking-transit economic balance.

Other devices used to increase ridership include the "Five Cent Downtown Shuttle System" and the use of peripheral parking lots. The service has been fairly successful, but McLary said that he hoped to increase its use with newer, more deluxe buses.

Madison has ordered 22 new buses to up-date their present fleet. The new buses are equipped with the latest non-polluting devices, the Environmental Impact Package, to insure minimal environmental effect. They will also be equipped with air conditioning and more comfortable interiors to induce people to use them.

The use of peripheral parking is in the experimental stage. Madison's Sherman Plaza peripheral parking lot was termed a flop by McLary. He explained that parking rates are still too cheap in the inner city to compel drivers to leave their cars on the outer edge of the city and bus in.

"I envision forms of transportation that we haven't even seen today."

McLary's philosophy is to make the most efficient use of what is presently available in transportation. However, he predicted new modes of transportation for the future, and the re-vitalization of the railroads.

"Twenty years from now, we'll probably see different transportation facilities. I envision forms of transportation that we haven't even seen today. Technology is getting more and more sophisticated," McLary said.

Thomas Favour, director of transportation planning for the Dane County Regional Planning Commission, agreed with McLary on fully utilizing the available means of transportation in Dane County.

However, Favour said "We want to come up with a transportation program that will come up with a program to forecast the travel demands of the future."

This can be accomplished by a mixture of transportation modes, street and highway improvements, and several low and non-capital alternatives which would involve policies to encourage private participation in mass transit facilities.

These low and non-capital transportation improvement activities have been encouraged by federal, state and local policies. They include:

•Staggering of work hours to reduce congestion at rush hours.
•Measures to encourage car pools.
•Increasing daytime parking rates in the central area.
•Lowering transit fares during off-peak hours.
•Reserving special lanes for buses.
•Issuing bus passes to encourage transit ridership.
•Developing peripheral parking lots.

Favour does not like the idea of constructing new road and highways to meet future transit demands. Rather, he would like to see more reliance on mass transit, such as trains or buses, that move more people with less vehicles.

Favour said, "Streets and roadways will still have dominant roles" but "People have to realize that we have to have balanced modes of transportation." There is a polarized situation between the people who demand new streets and highways for their cars and the people who demand mass transit.

Favour is proud of Madison's efforts regarding transportation. He said, "Madison is one of the more enlightened areas of the country in meeting transportation demands. It's developing an innovative, progressive program."

On the state level, Governor Patrick Lucey appointed a task force in 1972 to study the current transportation situation. It published its report in the summer of 1973, in two phases. The first phase urged immediate aid for mass transit to keep mass transit at its present level of service."

The second phase concerned the development of long range technology for future transit needs.

"New modes must be found that are both safe and relatively low in cost."

A result of the task force study was the inclusion of $7 million for the specific purpose of mass transit, in the 1973-75 biennium budget passed by the Wisconsin State Legislature. This was the first time the state of Wisconsin allotted funds for mass transit.

Five million dollars of this money is designated for current mass transit needs and will subsidize the services of communities for aid. All but two communities having bus systems, Milwuakee and Waukesha, have requested subsidies. The remaining $2 million will go for planning and demonstration for the future.

who apply for aid. All but two communities having bus systems, Milwaukee and Waukesha, have requested subsidies. The remaining $2 million will go for planning and demonstration for the future.

The task force also recommended the development of new facilities, techniques and methods. Efforts should be made to bring space-age technology and other technological developments to Wisconsin, such as emerging energy technologies that provide alternative fuel supplies from petroleum, the study said.

It recommended that the governor create an energy council of scientists, state representatives and citizens to evaluate energy resources for the state transportation program. It also suggested that the state keep an inventory of its energy supplies to insure a 30-day supply of energy for mass transit.

It issued several recommendations on land-use and planning. These involved such factors as special, preferential lanes for mass transit on newly constructed highways and environmental impact studies that must be taken before developing any new transit mode.

The task force recommended the development of either air or ground interurban transit to connect the state's communities by 1990, and proposed auto-trains to Wisconsin's northern areas to serve recreation areas.

The task force proposed many other recommendations for mass transit that demonstrated that flexibility and foresight could probably meet the demands of Wisconsin's transportation needs, if adopted.

The environment and the economy are key factors in any new developments. New modes must be found that are both safe and relatively low in cost to answer the future's demands.

Experts on federal, state and local levels agree that there must be heavier reliance on mass transit in the future. They also agree that providing the necessry mass transit will be a challenging, and at times a frustrating process that will strongly test their innovative powers. WE

warm water reduces future waves

By JIM NAPOLI
UW Science Writer

MADISON, Wis.—Harbor sloshing, a phenomenon that can tear small boats from their moorings and wreak havoc in marinas, can be reduced with warm water, perhaps from electric power plants.

Theodore Green, civil and environmental engineer at the University of Wisconsin-Madison, has found that by injecting warm water into the bottom of a water body, like a harbor, it is possible to cause the force of the sloshing to diminish or decay.

"Although no statistics are available, every year a large number of small boats, including many in the Great Lakes, are damaged when they are carried away by the sloshing, called harbor oscillation or seiche," says Green.

A seiche creates long, horizontal waves that move pendulum-fashion across the harbor and can build into powerful currents—even when the water surface looks perfectly calm. A seiche, moving rhythmically like water sloshing in a bathtub, is generated either by wind or by waves from outside the harbor.

In a project funded by the Sea Grant program of the National Oceanic and Atmospheric Administration, Green found that if warm water is introduced into the bottom of a water basin, the lighter warm water rises and mixes with the cooler surface water. This mass transfer in turn reduces both the horizontal and vertical motion of the seiche, Green explains.

Although his findings have been tested only under laboratory conditions so far, Green sees a number of possible practical applications.

"Small marinas plagued with harbor oscillations could lay pipes for bottom injection of warm water to reduce the sometimes tremendous currents that build up," Green speculates. He adds, however, that this would probably be too expensive in most situations.

But the mass of warm water that would be needed for such an undertaking is already available at certain locations, namely, at power plant sites.

"It's not too far-fetched that warm-water effluents from power plants could be used to reduce seiching in marinas near or adjoining the plants," says Green.

The force required for injection would be small, since the warm water would be buoyant and rise of its own accord. The mixing action caused by the rising warm water and sinking cool water could also help flush the harbor of pollutants.

"Another attractive side effect, at least for areas where harbors freeze up in the winter, is that the warmed water would keep the harbor or marina ice-free for a longer portion of the year," Green adds.

In the laboratory, waves are created by the rhythmical movement of a paddle-like apparatus in a basin 12 feet long and three and one half feet wide.

The turbulence is created in the laboratory harbor by a grid that heats the bottom water. The greater the difference between the top and bottom water temperatures, the greater the decay rate of the oscillations.

"We don't know exactly what happens to the wave or oscillation as it passes over turbulence and is diminished. But we know it happens and we may be able to make use of it," Green asserts. WE

Traffic Flows With Technology

by Peter Scheer
of the Engineer Staff

About the Author

Peter Scheer is a new member of the WISCONSIN ENGINEER staff. A graduate of Brooklyn Technical High School, Pete received an A.A.S. in automotive technology from S.U. N.Y. at Farmingdale. He is now a junior in mechanical engineering.

The problem is simple. Devise a system for moving people from here to there. The system must be clean, fast, efficient and inexpensive for the commuter. For years, engineers have been looking for the answer, but so far nothing has been developed to fully satisfy the public as the automobile does.

In recent years, we have seen an increase in research of inter and intra-city transportation facilities. Spurred by the problems of air pollution, fuel shortages, and traffic congestion, federal and state governments have made an earnest effort to investigate all possibiliies of easing these situations.

In general there are three ways to deal with these problems. First, restrictions can be placed on vehicular movement in high traffic density area. Second, existing traffic and transit facilities can be made to operate more efficiently. Third, new methods of transportation can be developed to get people to their destinations quickly and efficiently and perhaps cause them to leave the automobile at home. Some ideas are new while others are new applications of established principles

Computors have successfully been used in many major U.S. cities to maximize traffic flow through light controlled intersections. The largest system is in New York City where approximately 40 miles and 350 intersections are computor controlled. It was originally proposed to widen a major street to ease congestion but a computor control system was successfully used instead and the same results were obtained at a much lower cost.

Sonic sensors, mounted on lightposts above the roadway, emit a 20 Khz signal which bounces off the street and is picked up by a transceiver relaying the signal to an IBM 1800 computor. Passing vehicles interrupt the signal and from the frequency and interval of interruptions the computor can calculate the speed, volume and density of traffic at that point. The computor matches this with one of over 500 preprogrammed traffic patterns and sends the appropriate timing sequence to the light control box-

. In addition to storing the traffic flow data for statistical analysis, the 1800 checks itself 60 times a second and if a breakdown of information should occur at any control box it automatically returns control to the original sequence in the box. In case of such failure, it is noted with a red light on a control board in the main office.

The results have been favorable. The number of stops decreased by 70 per cent and driving time is 35 per cent less for one particular road. Less stoping, starting and idling at red lights has also reduced emmissions.

Kansas City uses a computor but not in direct traffic control. Traffic flow and density data are fed into a computor and an optimum light sequence is obtained for each intersection. This sequence is manually set in the control boxes. When traffic conditions change significantly, engineers run a new program and a new sequence is obtained. This system is much less elaborate and expensive than the previous system but it lacks the flexibility to meet changing traffic conditions.

At Expo '67, Montreal offered its visitors the comfortable, rubber tired Metro train and one 4 mile section of automated train service. The train accelerated, braked, and negotiated curves all by the direction of a computor. It was only an exhibition at the time but today a complete automated system is in operation in San Francisco.

The San Francisco line was built with Westinghouse automated train control components. Its maximum speed over the 75 mile route is 80 miles per hour with an average of 50 m.p.h. This average is significant because it will be more attractive to riders than present subways with average speeds of 20-30 m.p.h.

During rush hours trains can be run as close as 90 seconds apart. A central computor controls all operations through information received from trackside relays placed at regular intervals. A passing train triggers the sending unit to read and relay the trains number, length, speed and destination. The information is changed to digital coding which is transmitted to the computor in the 5-10 khz range. The computor can make route changes, add or delete trains, adjust speed and station stopping times to maximize overall efficiency.

Transit busses have also been subject to improvement. New power sources have been investigated to replace the smokey diesels now in service. Turbine, steam and electric busses have been build but their drawbacks are too great to put them into full service at this time.

Perhaps the most promising concept is that of an energy storing hybrid powerplant. Such a design uses a conventional internal combustion engine built has a means for storing energy which would otherwise be wasted in braking. In this way a smaller engine can be used, and by keeping in a loaded, constant speed condition, fuel economy is improved and pollutants decrease.

"Commuters will not trade . . . unless it becomes far too expensive"

One such system, developed on the U.W. campus by Professor Otis, stores energy in the form of compressed gas. The system consists of a pump-motor, a valve directing fluid flow, and a tank holding the gas. When decelerating the valve is moved to allow the pump to force fluid into the tank compressing the gas. This in effect is converting the kinetc energy of the vehicle into potential energy of the gas. Moving the valve the other way allows this compressed gas energy to force fluid back through the pump-motor driving the vehicle forward. Basically the system is as simple as this, but the complete design includes a variable pump and valves to keep proper pressures in the tank and to keep the engine loaded.

Such a design is ideal for the stop and go driving conditions of a bus or any other short-run urban vehicle.

Another design is that of Lockheed Aircraft Co. Instead of energy in compressed gas they use a flywheels momentum. A 20.5 in. diameter steel flywheel weighing 42 lbs. turns up to 24,000 rpm in a partially evacuated enclosure. The partial vacuum is to prevent the flywheel from burning up due to air friction. Lockheed wants to use a hydrostatic transmission to fully recover and reuse the energy of the vehicle. A hydrostatic transmission is basically a variable hydraulic pump which offers an infinite number of gear ratios. Lockheed is also involved in the possibility of fitting flywheels to electric buses now in service.

Pedestrian transportation has not been ignored. Conveyor belts have long been thought of to move people, but the greatest problem has been of getting on and off the belt safely. This required that belt speeds be kept quite low and passanger volume has not made it as efficient as shuttle buses. Battalle Industries has developed an entrance ramp to solve this problem. "Speedaway" as it is called, is a system of interlocking slats, much like an escalator but with the ability to slip sideways. The slats start nearly parallel to the beltway and as they approach it they begin to slip sideways in a parabolic path and speed increase. Two different types of drives are needed for the "Speedway". A constant speed motor driving coarse worn gears are used for the low speed section and a linear induction motor drives the curved acceleration section. These drives are linked to the belt drive by a computor which keeps torque and power even and compensates for load changes. With the use of "Speedway", belt speeds can be increased to 15 m.p.h. or more. London is seriously considering the use of this beltway for pedestrians crossing the new London Bridge. Presently a full scale prototype is successfully in operation in Switzerland.

Of the systems covered above, the automated train and the Hybrid vehicles are the most practical of the solutions. Commutors will not trade the convienience of their cars for anything else unless it becomes far too expensive not to. The Hybrid vehicles can give the traveller his speed and convenience, while decreasing fuel consumption and pollution. The automated train, however, may be more attractive in dense urban centers where surface traffic could not move as freely. WE

R. Byron Bird

Chemical Engineering

The University of Wisconsin's chemical engineering department is considered to be the finest in the world by many professionals, primarily due to its faculty. Prof. R. Byron Bird is frequently mentioned in discussions of chemical engineering and has received national acclaim for his theoretical chemical research at Wisconsin.

After receiving his Bachelor of Science degree in chemical engineering at the University of Illinois, Prof. Bird came to the University of Wisconsin to earn his PhD in physical chemistry in 1950. At Wisconsin, he studied statistical mechanics of gases and the kinetic theory of gases. In 1950, he left as a Fulbright Fellow to the Netherlands, where he took up research in spectroscopy and quantum mechanic properties of gases. He returned to Wisconsin in 1951 to continue his study of kinetic theory and statistical mechanics of gases. In 1952, he went to Cornell University for chemistry research, but was invited back to Wisconsin a year later.

As Prof. Bird relates, "Prof. Haugen specifically wanted someone to develop the field of transport phenomena and fluid dynamics. It sounded like a very challenging thing to do, and there was nobody working in the field here." Prof. Bird is recently involved in rheology research, the study of flow, deformation, and stresses in many kinds of solids and liquids, and research in the field of fluid dynamics of polymer solutions.

How does he like it here at the University of Wisconsin? "It's a first-class university — there's no question about that. It's located in a very pleasant city. It's not in a congested place — in fact, it's probably the only major university that's located in a fairly nice place."

While excelling in many aspects of chemistry and chemical engineering, this apparently was not Prof. Bird's first choice of occupation. According to Prof. Bird, "When I went to college, I wanted to major in foreign languages, and my father said that he wouldn't pay my college education if I majored in anything that was that useless. So he said he didn't care what kind of engineering it was as long as it was engineering. I decided, if it was going to be engineering, I'd pick the hardest one, so after looking over the curricula, that one seemed the most challenging."

The study of languages is still a very integral part of Prof. Bird's life. He is fluent in Dutch, French, German, ad Japanese. He helped found the Dutch club on campus, now in its twenty-second year, and attempted to develop a course on technical Japanese which was offered last summer, but attracted only one student. Prof. Bird, now busy preparing a text in Japanese, explained a portion of his work: "We did a study a few years back on the frequency of occurrence of technical characters in technical Japanese, so we now have a list of over five hundred characters. We can tell you the frequency with which they occur in physics, chemistry, and biology."

Intellectual challenges are not all that attract Prof. Bird's interest. He is also much of an outdoors enthusiast. He has been back-packing throughout the world, and enjoys making the effort of riding his bike three miles to school every day, "Canoeing," he confesses, "is my main thing. I like back-packing, too, but I've been on many more canoe trips." Prof. Bird keeps track of his canoeing adventures of which there are twenty-eight in all, in the rear of his thermodynamics book. A memorable trip was made two summers ago, when he spent three weeks canoeing in the Northwest Territories of Canada 320 miles to the Arctic Ocean.

Prof. Bird has received many outstanding awards. He was a Fulbright Fellow and Lecturer and Gugenheim Fellow in Holland and Japan, served as chemical engineering department chairman and was named the Charles F. Burgess Distinguished Professor of Chemical Engineering at the University of Wisconsin in 1968. He has been awarded the Curtis McGraw and Westinghouse Awards by the American Institute of Chemical Engineers. He was elected to membership in the National Academy of Engineering in 1969, and in 1970 elected to fellowship in the American Physical Society. In addition, Prof. Bird has served as a member of several chemical societies, advisory boards, and lecture tours.

Cable Tunes – In Potential

by
Jeff
Kratz
of the Engineer Staff

Cable television has unlimited potential. How many times that sentence has been spoken can never be known. Nearly everyone with any kind of knowledge of cable television has said or thought it at one time or another.

Yet, there's something wrong with that sentence. Not so much in what it says; more in what it implies. "Potential" seems to refer to the future, to the need for improved technology.

Improved technology is needed for cable television to reach its full potential. But present day methods and equipment are far beyond the level of just importing old movies from Chicago. Cable television today can be used as a vital part of engineering research and can provide well paying jobs in a fast growing field to qualified personnel.

Both Madison businessmen and the University of Wisconsin are moving to more fully exploit the myriad of possibilities offered by cable broadcasting today.

At the present time Madison has one commercial cable television franchise, Complete Channel Television, Inc. Established under a ten-year charter granted by the Madison City Council in 1965, Complete Channel TV has been "on the air" less than six months. Currently, only twelve channels are offered, but plans are being made for an eventual expansion to thirty channels.

Rod Thole, general manager of Complete Channel TV, looks beyond the simple expansion to more channels. "Cable television can be a very real benefit to the entire Madison community," said Thole. "I'm looking forward to the time when the entire city will have the opportunity to get cable TV."

Right now, Thole says only parts of the city, mostly on the

West Side, have the necessary cable lines strung to enable Complete Channel TV engineers to provide service to private homes. Thole hopes the operation to string wires to cover the entire city, a project requiring 477 miles of cable, will be completed by the end of 1974.

"Running our cable above ground makes us vulnerable to electrical storms and other environmental hazards just like the electric company or anybody else," he said. "Costs for laying underground cables are just starting to become competitive with above ground costs. If we had it to do over again, if we could start fresh, we would definitely consider putting our lines underground."

Because of the tremendous expenses involved with running a cable operation, and because of the cluttering effect of two cable companies having to run wires over the same street areas, the City Council has so far refused to enfranchise other cable systems in Madison. However, there is always this possibility, Thole points out.

Thole admits being the only cable business in town has its economic advantages, but says it presents challenges as well.

"In a city like Madison, cable is operating in an unique atmosphere," he said. "The Governor's Task Force on cable TV was based here, there is the Mayor's ad hoc committee on cable, and many people in the University community know quite a bit about cable. A lot of people know what cable is, and, more importantly, know what it can be made to do.

"It could be used to allow fuller participation in live educational experiences."

This forces us to try and run a first-class operation."

A part of this drive to please a knowledgeable clientele involves Complete Channel TV's plans to hook up with the University of Wisconsin's campus cable system. The University of Wisconsin-Extension, which operates the cable television facilities on campus, is allowing Complete Channel TV to install a modulator in Vilas Hall. This could pave the way for possible distribution of University programming to the community at large.

Complete Channel TV's relations with the university have not always been this cordial. WHA-TV, the university-owned educational station in Madison, at one time filed an objection with the Federal Comunications Commission (FCC) concerning plans by Complete Channel TV to import the educational station from Milwaukee. Claiming their audience would be affected by the importation of a station that carried much of the same material they ran, executives of WHA-TV did not want WMVS-TV from Milwaukee piped into Madison. They dropped their objections at the insistence of the University's Board of Regents.

Thole claims there are no hard feelings over the incident, and that his corporation's dealings with the university officials now are very friendly. "The people at the university have been very helpful with the arrangements for our hook-up with their system," he said. "As soon as our lines get run into the university area, we will tie into Vilas Hall at our own expense."

Vilas Hall, located at the corner of University Avenue and Park Street, houses the broadcast facilities for WHA-TV and radio, and serves as headquarters for the campus closed-cirucit cable television system.

"I beleive the university system and our system can compliment each other. I believe it is to our mutual advantage to be able to tie into each other's programming," Thole said.

The university system at the present time is not much to tie into, according to Allan Hinderstein, manager of instructional television production for the University of Wisconsin-Extension telecommunications center.

"The cable system on campus now is really obsolete," said Hinderstein. "Only 20 or so locations are wired-in on this campus. Also, only four channels are available, and the system uses tube amplifiers, which gives us a low quality picture."

The Chemical, Civil, and Electrical Engineering building is the only one on the engineering campus that is hooked into the present system. Moreover, it is tied in only by a drop in the basement, according to Hinderstein. Cables must then be run from the basement inside the building to wherever the monitor is located.

While the present system is hardly practical for extensive use by today's standards, Hinderstein says there once was a time when cable television was widely used on the Madison campus. "For a long time television was a service provided free by the University President's office," he said. "You had professors taping entire lectures to be shown at a later time."

"There is a crying need for qualified engineering help right now."

Seven years ago, campus cable was reorganized into the new Extension system, and with the reshuffle came the end of televised lectures.

"It became impractical to use cable television to teach classes for three main reasons," said Hinderstein. "First, television was no longer provided free. Second, some of the equipment started to break down or become obsolete. Third, and probably most important, the Extension put more emphasis on creating short instructional materials rather than taping whole lectures."

But while these factors make the present system largely impractical as a lecture replacement, plans are in the works to construct a new cable system on campus. This new system would open up many new outlets around the campus, and let cable television be used in an informational manner as never before.

"The proposed system would add at least 42 more outlets to the present set-up," said Hinderstein, "Not only class buildings, but labs and libraries would be included as well."

Hinderstein stresses the new system would not replace the professor in the classroom. He said the new system would lend itself better to producing

Installing Cable

models—short, instructional teaching supplements rather than regular taped lectures.

Another aspect of the new system would be the potential to share data and observations on in-progress research experiments. Laboratories around the campus would be part of the system, allowing the observation of experiments from many different points.

The Engineering Research building, Mechanical Engineering, Metallurgical and Mining Engineering, the Solar Energy Research Lab, and T-23 and T-24 would all be wired-in as a part of the proposed system. These buildings would then be linked to the Chemical, Civil, and Electical Engineering building, to each other, and to all the other tied-in buildings.

"Cable television would be able to do more than just teach a specific lesson," explained Hinderstein. "It could also be used as a means to allow fuller participation in live educational experiences. It would allow for the transfer and storage of projects and results from labs for use at a future time."

Hinderstein says there are no plans at the present time for any interconnecting cable system between University of Wisconsin campuses, but did not necessarily rule out any such developments in the future. He claims that, theoretically, cable could be the answer to plans to close some graduate schools on different university campuses. He contends cable technology would make it possible for a student to "attend" one campus, yet get instruction and talk with professors from another campus.

Such a plan would require the approval of the state legislature, and at least one expert has warned that a state legislature already paying for an over-the-air state educational television system may not be anxious to pay for another closed system.

Before the legislature could turn to considering the university's closed system, it first must determine what restrictions, if any, it will impose on state commercial cable television. Now pending before the lawmakers is a bill backed by Governor Lucey that would allow local municipalities to continue to franchise cable television operations, but would subject those operations to state regulations regarding both technical and programming standards. A new division would be created in the Public Service Commission to oversee this regulation.

State legislators floor managing the bill say it should have no effect on any university plans to operate a state-wide on-campus system. The legislators believe that since the state would have to give permission before any such action could be undertaken, any problems with existing law could be ironed out when the new bill was introduced.

However, the pending bill would place commercial cablecasters subject to state regulations over and above any local laws. This spectre of state cable-watching does not altogether please Rod Thole. "This bill would just create another tier of government," he said. "It's possible the state may be too uniform in its guidlines, forcing some cable operators to meet requirements that are not practical in their communities."

At present, Madison and the FCC both have laws regulating cable television. While most of the FCC rules are very general or deal with technological specifics, one court case recently decided in Washington may have some effect on future federal cable regulations.

A Court of Appeals in the nation's capital has ruled that cable operators must pay a copyright fee to import stations from outside the operator's normal market area. This means, for example, Complete Channel TV may have to pay WGN-TV copyright fees to import Channel 9 from Chicago, something it has not had to do previously.

It is unclear how this new ruling would effect a university owned state cable system, importing signals from all over the state. The situation could be complicated even further if and when commercial stations like Complete Channel TV tie into the university system.

Both Thole and Hinderstein allude to the potential for the growth of cable television both as an educational tool and as a commercial medium. Thole especially stresses the fast growing nature of the field and the opportunities that are open to qualified people.

"There is a crying need for qualified engineering help right now," he said. "Someone with a good knowledge of the electrical technology of cable television is going to be in demand."

Cable television's potential may still lie undiscovered or only half realized in the future. But cable television is a reality today. Both on the University of Wisconsin campus and in the commercial world, cable television offers the engineer a tool to a better education and a possible successful career. WE

About the Author

JEFF KRATZ, a member of the ENGINEER staff, is a senior in the School of Journalism. Jeff is from Whitefish Bay, Wisconsin and has written for the Daily Cardinal. After graduation he plans to work in either newspaper or magazine journalism.

Students Live and Learn in Mexico

In the fall of 1961 a new program began within the College of Engineering. It was an opportunity for engineering students to have a "Junior Year Abroad." In those days study abroad for U.S. college students was still a relatively new thing.

El Instituto Tecnologico y de Estudios Superiores de Monterrey in Monterrey, Mexico was chosen as the location for this "study abroad" enterprise for engineering students and the name given it was the Wisconsin-Monterrey Tec Program. For several years Case Western Reserve and Stanford University also sent participants. At this writing however, Colorado State at Fort Collins and Cornell University in Ithaca, New York are the only other participating schools.

Each summer some of our engineering students, having qualified to be participants, depart for Monterrey and the Tec campus. They spend six weeks in intensive advanced study of Spanish and at the same time get acquainted with their new collegiate surroundings. Between the end of the summer session and the start of their academic year in Mexico, they have a ten day vacation trip.

This trip takes the students to Mexico City, Puebla and Acapulco and gives them an opportunity to get acquainted with the southern part of Mexico. It is however only one of the many trips taken during the year. Some students come back from their year in Mexico having seen more of that country than those who live there.

The school year begins in late August at the Tec and our students attend classes just as they would on our campus. The difference is that all the verbal communication is of course in Spanish; a few of the text books however are in English. The participants live on campus, in the Tec dorms, each with a Mexican student for a roommate. The second semester some choose to live in apartments with other Mexican students or a Mexican family.

Perhaps the best way to tell what the Wisconsin-Monterrey Tec Program is all about is through a couple of quotes from the reports of past participants.

Ken Heising, now a graduate student in I.E., was a participant in 1970-71. He wrote, "The year could be summarized as a continuous learning experience. The best way to understand a country is to understand the people of which it is composed. Too many people, especially Americans, try to judge a country by comparing it to their homeland. I remember being told by one of my professors at the Tec, "The sooner the U.S. realized, that what is good for the U.S. is not necessarily good for Mexico, the faster our two countries will grow in friendship."

Greg Becker, also a 1970-71 participant wrote, "This program has already had and will continue to have a profound effect on my life. I find myself with a new self-confidence and a greatly expanded outlook on life. I have learned to look at another person without trying to make judgments about his or her personality or way of life. Instead, I only say to myself, 'it is different,' and then I try to understand why it is different. This maturing process I feel has been a direct result of my participation in the program."

If you would like more information about the Wisconsin-Monterrey Tec Program, call or stop in at the Engineering Foreign Programs Office, Room 439 Engineering Research Building. The phone number is 263-1612. WE

Administration Building on the Monterrey Tec Campus.

A Taste of the 'Real World'

by Jim Widmaier

Cooperative education programs are not popular at the University of Wisconsin, but under the right circumstances such a program can be a valuable asset to the educational development of an engineering student.

What is cooperative education? Such a program is usually initiated by a corporation with the cooperation of the College of Engineering. Students are selected to participate in the program which usually alternates a semester of schooling with a semester of on-the-job training. Certain Universities have developed detailed co-op programs. General Motors Institute and Northwestern University are two midwestern schools that encourage the coop program.

Many graduating seniors enter the "real world" with no advance knowledge of what it has to offer. These graduates hesitate when considering job opportunities and many end up making an undesirable decision because they were disillusioned about their new job and soon learned that their interests and aptitudes are in other fields.

Cooperative eduction programs provide the opportunity to gain insight into the workings of a company and also aquaint the student engineer with situations and problems that allow him to apply the techniques, theory and tools he labored to learn in his college environment. He either learns that he is in the right field or he learns, before it's to late, that he might be happier, elsewhere. A minimum benefit of the program is the first-hand experience of working with engineers and managers on projects that have real and meaningful applications. In addition, most co-op programs end with a lucrative job offer by the cooperating company.

As a graduating senior in the Industrial Engineering Department, I would like to relate the details of a Co-op experience that I had with S.C. Johnson and Son in Racine, Wisconsin.

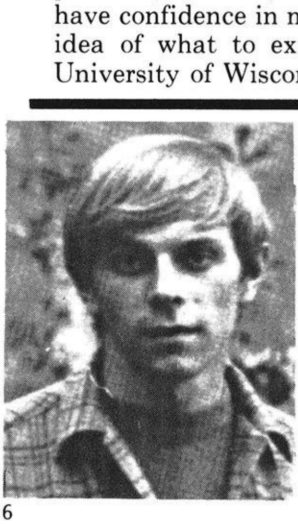
As a second semester junior, I began to question the importance of certain course requirements and found it difficult to relate their importance to my future career interests. I had often considered the co-op program, but there was not a strong interest in co-oping at this university, so my interests shifted to summer employment with a company hiring student engineers. After an unsuccessful attempt to secure a summer engineering job, I returned to school in the fall semester of 1971, still questioning what the "real world" was all about. During that semester Johnson Wax approached our department with an interest in starting a co-op program. Prof. Gordon Robinson sollicitted student interest and coordinated the development of the program with the Johnson Wax personnel department.

The first portion of the program consisted of a basic orientation with the distribution engineering department. As I became familiar with the workings of the department I was given job responsibilities at a comfortable rate. Nearly all of these projects challenged my abilities to use my engineering knowledge. More important, I learned the value of group efforts and quickly learned that I would be working with many different personalities. To say the least, I learned a lot from working with people. The first segment of the co-op program lasted the entire Spring 1972 semester. I worked on a full time basis and was paid a competetive student engineering salary.

I returned to school for the fall 1972 semester with a better understanding of my interests, an insight into the workings of a company and a little extra spending money. The courses I selected for that semester were influenced by my work experience. In addition, theoretical problems that usually "snowed" me became clear because I was able to relate a "real life" situation.

My final working semester began in January 1973 and extended into the summer months. This was an active and demanding semester. Besides working in the distribution engineering department, I was exposed to the maintenance department, component manufacturing deparment, and the production control department. Again, many projects required the use of various engineering techniques. In fact, one project satisfied a course requirement and upon completion of a detailed report, I was awarded three credits.

Now that I am in my last semester the benefits of the program are beginning to materialze. Although the program added one year to my education, it can be regarded as a year of work experience. The experience, however, is secondary to the fact that I now have confidence in my career choice and have a good idea of what to expect as I prepare to leave the University of Wisconsin this December. WE

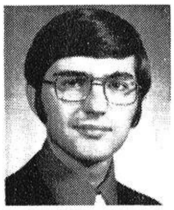


About the Author

Jim Widmier is a senior in Industrial Engineering. Jim is a past National Vice-Chief of the Order of the Arrow of Boy Scouts of American, has co-oped at Johnson's Wax in Racine for the past two years, and is currently Regent of Theta Tau Professional Engineering Fraternity.

Ch.E.'s are in demand*

To do what? Some recent experiences:



B.S.Ch.E., University of Nebraska '73

He picked the Kodak Research Laboratories.

Why research?

Answer: "The challenge of studying the unknown."

Translation: "Science and engineering are different. In this spot I think I'll be able to go either way. Or both."

B.S.Ch.E., Lehigh University '73

He picked industrial engineering.

Why industrial engineering?

Answer: "Gives me a chance to utilize my background working with people."

Translation: "There is more to life than thermodynamics."

B.S.Ch.E., Worcester Polytechnic Institute '73

He picked product development.

Why product development?

Answer: "A good product which the customer appreciates fulfills the Product Development Engineer's need for satisfaction in his work."

Translation: "After two weeks of my Kodak career, the future looks good."

B.S.Ch.E., Oklahoma State University '72

She picked manufacturing staff.

Why manufacturing staff?

Answer: "Offers a chance to work closely with operations in the field of pollution control."

Translation: "Those power plant stacks are now *my* stacks."

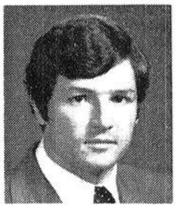
B.S.Ch.E., Carnegie-Mellon '72

He picked process development.

Why process development?

Answer: "Challenge and creativity."

Translation: "Actually, I'm already spending half my time on product development. Keep loose and you do O.K."



B.S.Ch.E., Virginia Tech '73

He picked sales.

Why sales?

Answer: "Because it is a career of travel and change, and because sales utilizes an entire person. A sales representative uses not only his intellect but all his powers of communication and persuasion to further his career."

Translation not required. Engineers who talk like that *ought* to be in sales.

Engineers are not hired for talent in vivid writing. If you'd like to be an engineer at Kodak, tell your Placement Office or notify Business and Technical Personnel, Eastman Kodak Company, Rochester, N.Y. 14650. Most of the actual openings are in Rochester, N.Y., or in Kingsport, Tenn., but not, by any means, all of them.

Kodak

An equal-opportunity employer m/f

*So are other engineers. These are interdisciplinary times. But you have to show you have mastered the old basics, whatever else you've mastered. Otherwise you won't understand the language spoken here.

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

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

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

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

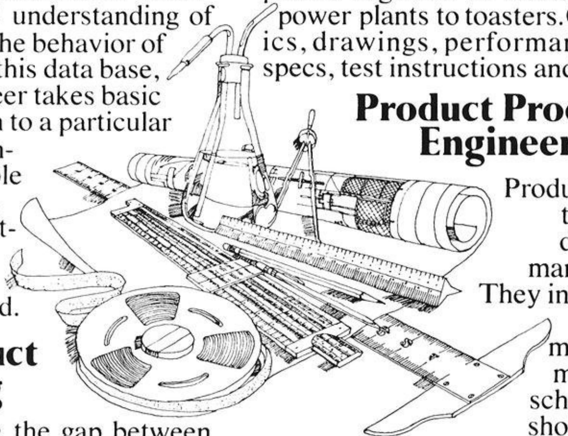
Basically, engineering at GE (and many other companies) can be divided into three areas. Developing and designing products and systems. Manufacturing products. Selling and servicing products.

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

We also have a handy guide that explains all three areas. For a free copy, just write: General Electric, Dept. AK-1, 570 Lexington Avenue, New York, New York 10022.

Basic/Applied Research Engineering

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



Advance Product Engineering

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

Product Design Engineering

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

Product Production Engineering

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

Engineering Management

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

GENERAL ELECTRIC

An Equal Opportunity Employer