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Volume 87, No. 2

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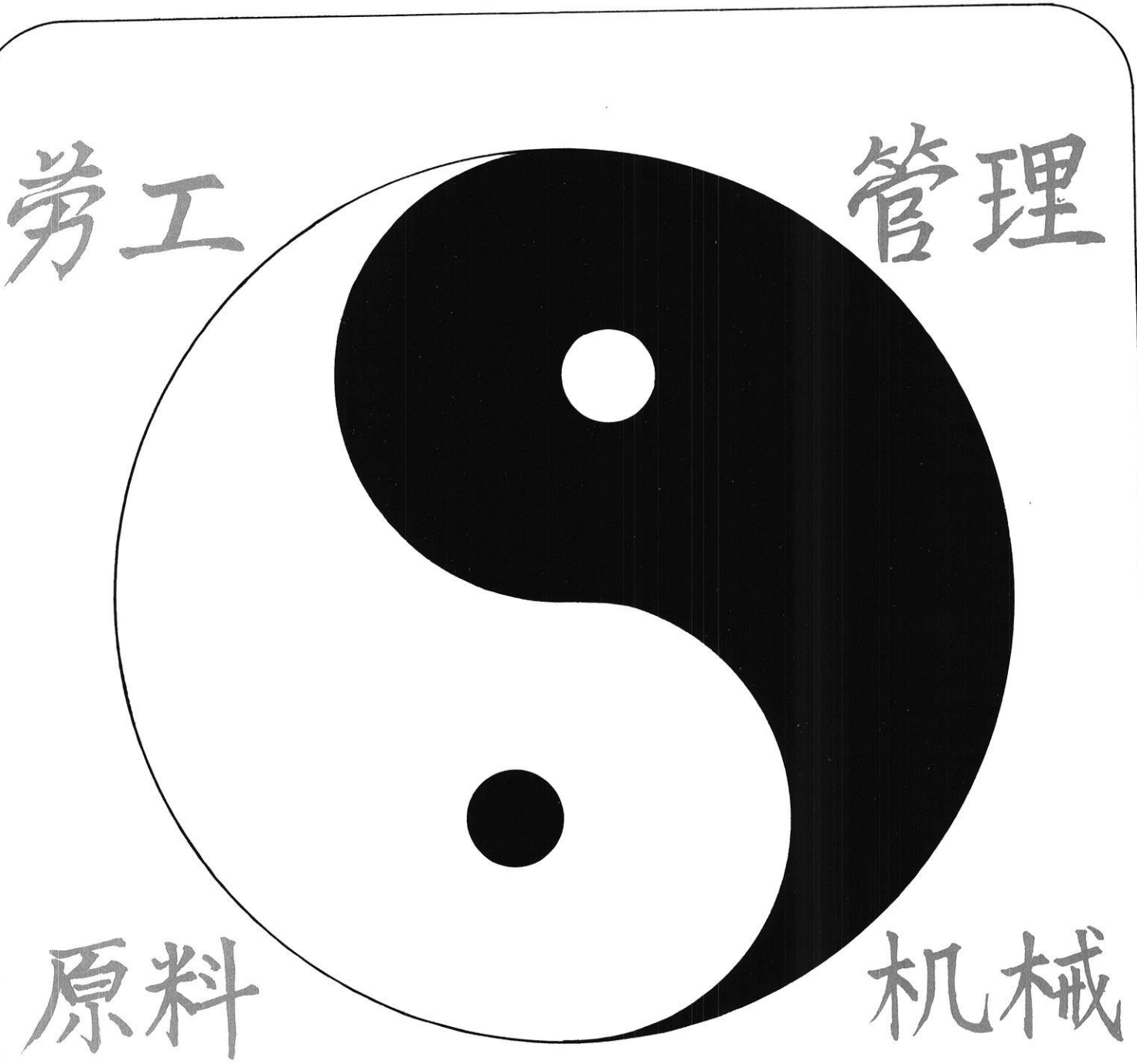
wisconsin engineer



Productivity: a question of essence

Luis Castellanos mines copper with software.

Most copper is found deep underground. But the Bell System's 995 million miles of copper cable have tons of it above and below ground. That copper provides vital circuit paths to transmit customer voice, data and video signals for today's Information Age needs.

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

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

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

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

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

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

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

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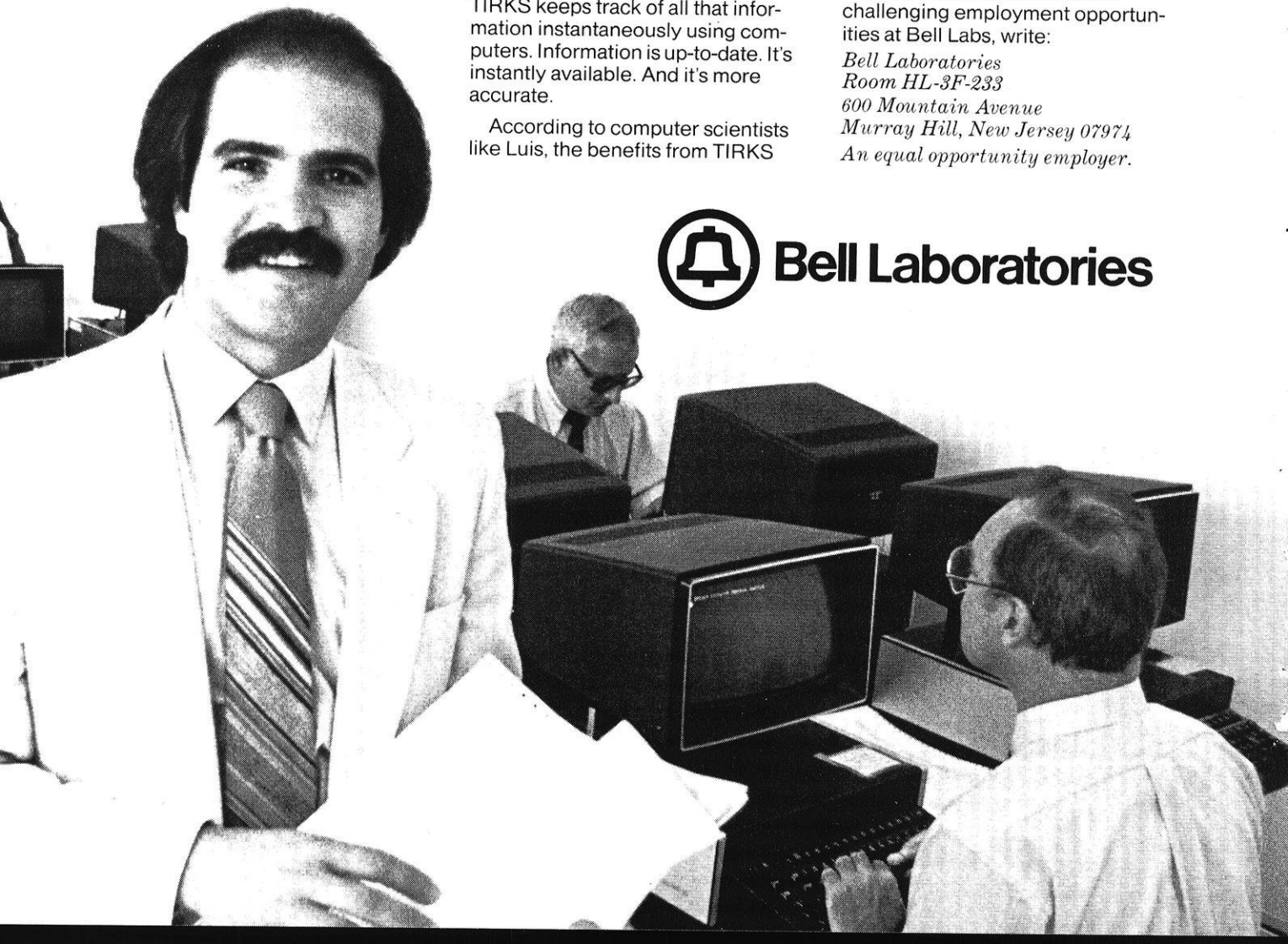
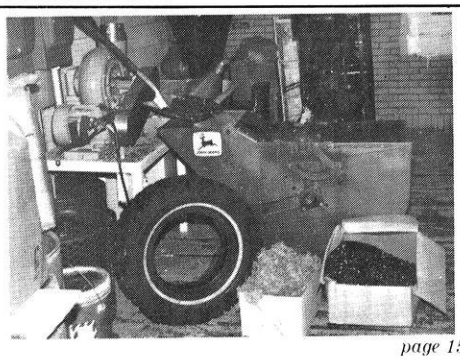


Bell Laboratories

wisconsin engineer

PUBLISHED BY THE ENGINEERING STUDENTS OF THE UNIVERSITY OF WISCONSIN-MADISON. December, 1982



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FEATURES

About the cover: the essence of productivity is how well raw material, machinery, management, and labor are combined. On the cover, created by Alicia Diehl and Man Ken Cheung, the Chinese characters for these four components circumvent the Tao, the symbol of wholeness.

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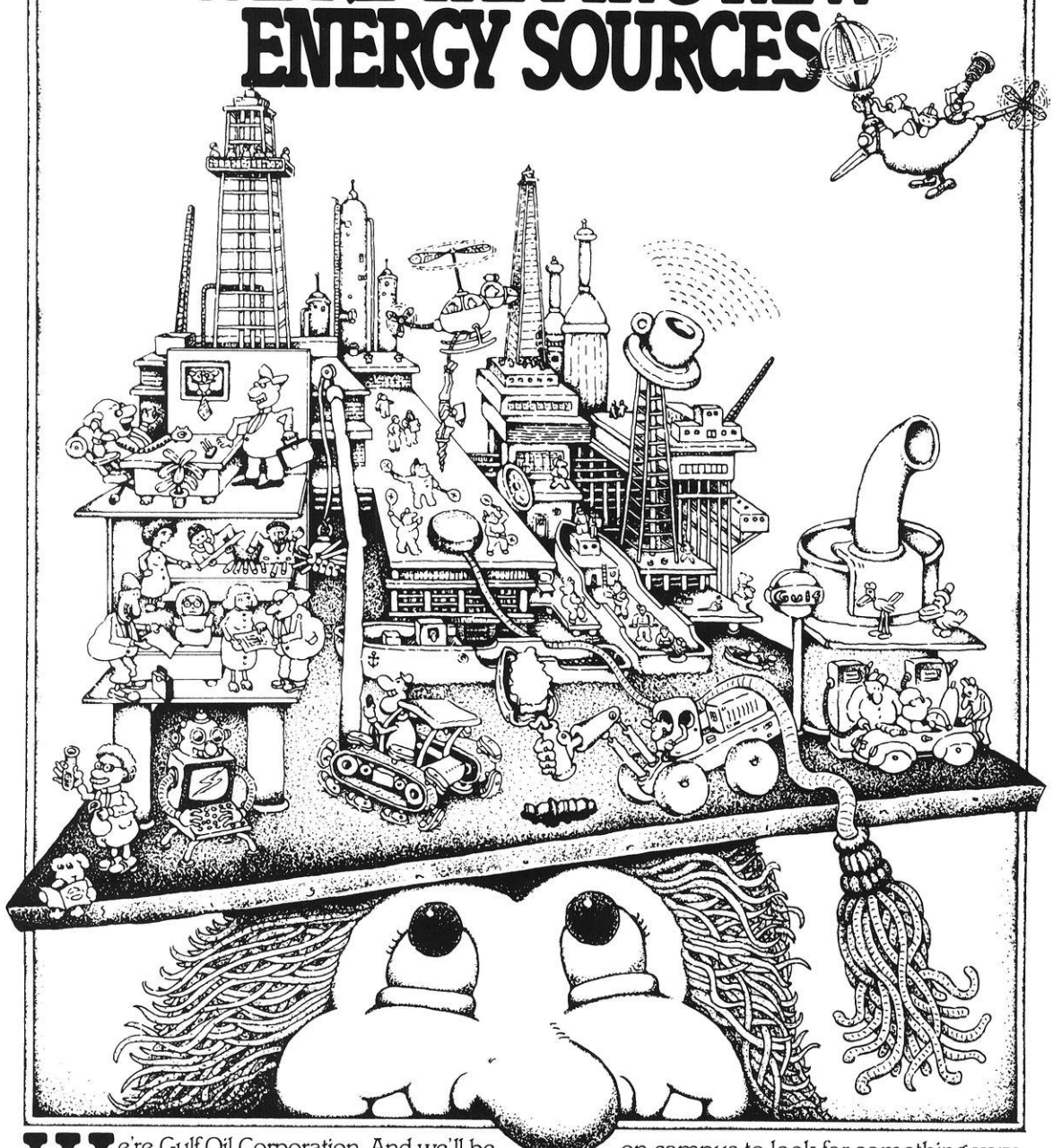

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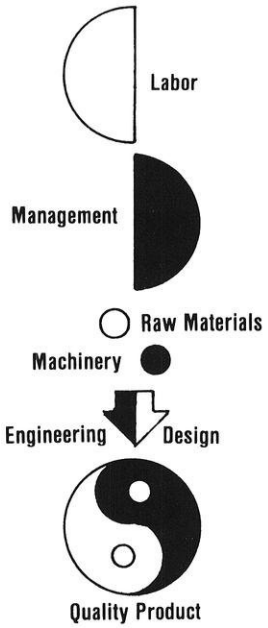
Editorial Designing for the Whole



Graphics by Alicia Diehl

Engineering design is the most important factor in industrial productivity for it combines the four basic components of any project: raw materials, machinery, labor, and management. A linear relationship can be drawn between each component. Obviously, the engineer designs the system by which the machinery processes the raw material. In the same light, the production layout design defines any interaction (or separation) a worker might have with the raw material (i.e. by means of safety barriers, etc.). The engineer also defines the relationship between labor and machinery by deciding where to place the controls and how often they need to be manipulated. But one relationship, that between management and labor, remains a fuzzy design parameter that an engineer might neglect.

Among management's duties is to see that the labor force completes its assigned tasks with maximum efficiency and economy. This is achieved by two methods: by offering adequate wages and benefits in return for labor completed; or by actually controlling the worker's performance on the job (referred to as *simple control*). In the old days, simple control meant looking over the worker's shoulder. After the industrial revolution, management could simply speed up the assembly line's conveyor belt and thereby force the worker to increase output by keeping pace. And finally, during the "computer revolution," engineers continue to provide management with means to exact simple control.

An office computer system marketed last year is of particular interest to this subject. The terminals for the office workers were one-way systems, while the manager had a two-way terminal. At the simple push of a button, the boss could see what the employees were up to without them even knowing it. To many workers, being on this system was much like working with the boss peering over one's shoulder from behind a see-through mirror. These office workers felt the same anxiety that was felt in the old days.

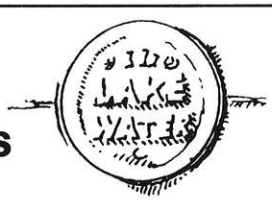
Though simple control was once an accepted practice, modern researches realize abusive methods have adverse effects upon labor productivity. (See this month's article on Quality of Working Life.) Workers subjected to simple control often feel less job satisfaction and often take it out on the company. The dissatisfied labor force is then more likely to sabotage, cheat, neglect, or leave his/her position in the company. When this happens, management has failed to maximize labor productivity, thereby proving the engineer had failed to design a proper management-labor interactive system.

There are two types of project failure for which the engineer is liable: structural failure, as when a bridge collapses and functional failure, as when the bridge only has one lane for a two-lane crossing. The creation of a hostile working environment, in the same light, is a functional failure of that design.

Engineers are liable for any functional failure created by managerial abuse of simple control methods available within design. If we are to design systems safe from failure, we must consider the human factors. Design criteria should include questions like: "How would I feel working at a one-way terminal?" as well as "How will I design the circuitry?" This way, a system safe from all failure is designed, and by properly designing the relationship between the four components, we can expect to maximize our industrial productivity. □

Lake Water

December's Monsters



by John Wengler

The darkness behind the window reflects an image as I lift my eyes from studying for finals. It's the face I see the most during finals week, and the eyes show the common terror seen in most students' eyes. Tired and cold, we students are just not in control this week. It seems the entire university wishes to ruin one's future by releasing this monster — exams. But the finals - demon is really our minds, as Captain Kirk realized during the *Star Trek* episode dealing with alien magic: Kirk analyzed a beast that was about to crush him, and under the control of his earth logic, the demon disappeared, revealing an alien magician trying to scare the captain away. As Kirk would not give up his mission, one must not be frightened by finals, but realize the beast is our imagination, and can be controlled by using a little creative logic.

Textbooks are the constant companion of the finals warrior. No wonder students become skiddish during finals week, being cooped up with this edition and that volume during the most critical point of a semester. (I couldn't think of worse company than a textbook and myself.) In a different light, a textbook can be one's best friend if the proper approach is taken (and one knows the proper chapters to study). If depression settles in, just consider the textbook's feelings knowing it will be placed on the used bookshelf as its student leaves for vacation.

An escape from the books is not always a relaxing break. Like the prisoner that escaped from Alcatraz only to perish in the Bay's chilly waters, one might run into another student wishing to narrate some personal sob stories. (This is the "I am in bigger trouble than thou" syndrome.) The best thing to do is listen, and offer a sentence or two of support. If that person is indeed in bigger trouble than thou, she/he benefits by releasing some steam, and one personally benefits in being warmed by the fact that things could be a lot worse. (A clear case of benevolent selfishness.)

I have long thought the Union ought to hire about 50 very nice people to listen to students complain about exam troubles. Wearing red sweaters, these smiling folks will sit and wait to soothe us like so many cups of hot cocoa. But since there is no money left over at the WSA to fund such a project, we will have to dig into our own chests to find these red sweaters. Finals week can be bearable when there is someone to talk to.

So we are now at the end of a semester's journey, lunging like a river off the cliffs upon arriving at the ocean. As the water panics and sprays at the foot of its fall, so must we transform all the words and equations into brilliant performances on the examinations. One last drive of fast and furious studying completes what we have come to do in the first place. □

QWL
A Better Industrial Engineering Idea

by Bonnie Buhrow

Bonnie Buhrow is an Industrial Engineering Senior and is also the feature editor of the Wisconsin Engineer.

Symptoms: High absenteeism. High turnover. A thick file of grievances. Poor product quality.

Prescription: Improve QWL - Quality of Work Life.

Business Week, in its September 21, 1981 report on the Second International Conference on Improving the Quality of Work Life, declared that "the perception is growing that QWL could form the basis of a new industrial relations system".

The basic tenet of QWL is that the workplace should become more democratic--employees should be allowed to take part in the decision-making process and to take responsibility for their work. This concept, once reserved for management alone, is a reversal of a century of industrial engineering thought.

Until recently, most industrial work design was based on the theories of Frederick W. Taylor, considered the father of scientific management. Scientific management carried the idea of division of labor to an extreme. Any task was to be fractionalized, that is, divided into the smallest possible segment of work. The "one-best-way" of doing each of these fraction tasks was determined by using time-study and work-measurement methods. Under this system of job design, which prescribed each movement and eliminated any decision-making by workers, employees were little more than replaceable machines.

The short-term benefits to management were impressive. Scientific management saved time on training and setup, and reduced scrap produced in learning the job. However, a costly long-term effect of this system was the build-up of bureaucracy. When responsibility was taken away from workers, increased levels of management became necessary to supervise and ensure that the work was getting done.

The negative aspects of the franctionalized, "one-best way" method of job design are increasingly outweighing the benefits in today's society due to changes in the work force, in technology, and in the business environment.

Work force. At the beginning of the century, the average worker had three years of formal education. Today, it is twelve years. These better-educated workers do not want to perform unstimulating, repetitive jobs day after day. Rather, they are demanding that their jobs provide mental, as well as economic, benefits. Workers are supported in their desire for more rewarding work by the welfare system and unemployment insurance. Over the years, the economic cost of refusing to take just any kind of job has been substantially reduced.

Technology. As jobs become increasingly automated and computerized production systems become more and more complex, workers will be required to respond to "stochastic", or randomly occuring conditions. Rather than pulling a lever five times a minute, the employee will monitor and fix a lever breakdown--the timing and nature of which is very unpredictable.

Business Environment. Companies in the 1980's face entirely different conditions from those which confronted firms in the 1880's. The environment today changes more rapidly and is more unpredictable. It is complicated by increased government regulation and much stiffer international competition. In order to survive, much less prosper, a firm has to be adaptable--and the one-best-way concept, with its attendant bureaucratization of decisions, is the antithesis of flexibility.

So, in today's world, QWL is a much better alternative than scientific management. Two QWL techniques which provide more job satisfaction, increase worker skill levels, and enable a company to adapt to changing conditions are semi-autonomous work groups and quality circles.

This tractor assembly line at J. I. Case Co. illustrates how factory workers often deal with only a small part of the product.

Semi-Autonomous Work Groups. Semi-autonomous work groups (SAWGs) are production teams. They are autonomous in that, while management decides what to produce and when it is needed, the workers themselves are responsible for how the production goals are reached. SAWGs take over former management functions of scheduling and manpower allocation. The jobs they perform are whole rather than fractionalized. Often the teams are responsible for purchasing the materials they work with, and for monitoring the quality of the product they ship to customers or to another department.

By creating SAWGs, plant managers usually increase employee morale, product quality, and productivity. For example, the self-managed work teams at the Shaklee Corporation of San Francisco (a producer of vitamins and other nutritional products) decide what hours to work, select new team members, and even initiate discharges. Productivity at the plant has increased from 30 to 88 units per manhour. A Digital Equipment's, Westmminster, Mass. computer-assembly plant, SAWGs are composed of four members, each possessing a different skill. The members train each other, so that each worker develops a large repertoire of skills. A team can assemble a computer 60% faster and uses 75% less space than a traditional assembly line.

Quality Circles. A quality circle is an on-going committee which examines and tries to solve production problems. It is ideally composed of a diagonal slice of the company, which includes members from the highest to the lowest level of the organization and from many different departments. The successful use of quality circles by the Japanese is famous. Quality circles are used in over 200 U.S. companies as well. Honeywell, in the belief that "people with high esteem are productive", has 350 quality circles involving 5% of its total workforce. At Malden Mills, suggestions made in a quality circle about use of materials and tools improved product quality. Correct fabric inspections rose from 88% to 94%.

QWL techniques do not produce a "quick fix". Management, unions, and workers used to operating under scientific management conditions usually undergo a slight culture shock when QWL is put into action. But with commitment and patience, improving QWL can reduce costly absenteeism and turnover, improve product quality and productivity, and help keep American companies strong and competitive. □

Industrial working conditions can become even more hazardous when the job routine is overly repetitious.

Engineering Management: 2 to 1 Your Future Career

by Chris Myhre

There are literally hundreds of thousands of engineers and scientists who, during the course of their careers, have been thrust into supervisory and/or managerial positions. Perhaps 80-85% of the technical graduates of U.S. institutions will become supervisors or managers sometime during their career. When they first enter these managerial positions they find they are unfamiliar with the problems and the skills needed to solve them. It was for this gap in knowledge and experience that a UW student chapter of the American Society for Engineering Management (ASEM) was formed this semester.

The purpose of the group is two-fold. The first is to give all engineering students an enlightened perspective towards a managerial career. The second is to offer a professional society for those engineering students for whom the prospect of working in management is a firm career option. The ASEM will organize speakers and programs to educate its members and others about the challenging and interesting problems that await a graduate outside of the technical arena in industry.

Graduates from all disciplines may find themselves interested in management careers. Because of this, the UW ASEM was instituted to cut across the various fields of study. As a result of this wide appeal, the UW ASEM is now 45 members strong with an active faculty advisor, Dr. Ken Kaneko, from the Industrial Engineering Department.

For the technically oriented student, ASEM is a stepping stone towards being an effective manager. If a student is in a technical major and has his/her eyes set on management, ASEM is for that student. For more information, please contact Chris Myhre (phone 231-2551) or Andy Lesko (phone 238-7777), charter officers of the UW chapter. □

Sticks in U.S. Spokes

by Marcella Thompson

The measuring stick for U.S. productivity is how well our products stack up on the international market, or more practically, how many foriegn shipping crates stack up on our shores. Marcella Thompson offers here a summary of the factors leading to the high concentration of foriegn products in the U.S. bicycle industry.

Photo by Steve Salvo

A trip to a bike shop is a pilgrimage of consumer awareness and patriotic inquiry for some of us.

Madison is regarded as Bike City U.S.A., a title bestowed by "Bicycle" magazine in 1981 and one it richly deserves. Madison has more bicycles per capita than any other city in the nation.

Eager to join bicycle enthusiasts--both to save face and feet--I hastened to the local bike shop. My eagerness soon transcended into consumer consciousness coupled with questions as to why the U.S. bikes weren't stacking up to the foreign models. Having been shown the entire stock, I soon discovered that it is extremely difficult to have quality, affordability, and the "Made in America" label simultaneously.

Commercial bikes are separated into two categories. There are custom bicycles and mass merchandised bicycles, constituting 30% and 70% of the U.S. market, respectively. Custom bikes are tailored for the serious rider and sold exclusively through bike shops. Manufacturers pay special attention to such features as the frame, welding techniques, and weight (lightness). The mass merchandised bike, on the other hand, is aimed at buyers whose primary concern is to simply purchase an affordable and ridable bicycle. These bikes are primarily sold through discount houses and retail stores. Since U.S. firms have concentrated their past efforts into mass merchandising, they have been left in the dust of foreign competitors producing higher quality custom-type bicycles.

Photo by Steve Salvo

Many of the custom bicycles sold in the U.S. are imported by European and Oriental companies, including TI Raleigh, Peugot, Sekai, Fuji, and others. The U.S. sports Schwinn, of Chicago, and Trek, of Waterloo, WI., as among its top producers of quality custom bicycles.

In the custom market, the U.S. manufacturer finds himself less competitive than foreign counterparts due to their contrasting production philosophies. Many European bicycle manufacturers have strong traditions in the art of bicyle making. While Europeans are motivated by a greater desire to create a quality product, the U.S. has seemed more inspired by profit margins and less by quality.

Japanese made bicycles have also proven to be a challenge to the U.S. custom market. Japan's attributes lie in its ability to produce bicycles more efficiently and its higher quality of tooling. Japan's solid reputation of quality car building is also transposed by buyers onto its bicycles. Surprisingly, it is their small companies which export to the U.S. since the larger firms concentrate solely on dealership in Japan.

When most people think of good quality U.S. bicycles, Schwinn undoubtedly comes to mind. Schwinn prides itself as being as "American as apple pie." This seems a bit contradictory since Schwinn, like so many other U.S. companies, uses a large amount of foreign parts in its bikes. In fact, since 1980, a large number of Schwinn bikes have been fully made and assembled abroad, while maintaining the Schwinn label and image.

continued on page 18.

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Accreditation Where Credit's Due

by Beth John

Students aren't the only ones who must get passing grades; in fact this fall the entire College of Engineering had to pass an exam to retain its authority to grant engineering degrees. A freshman engineer, Beth John enjoyed turning the tables and discussing how the "teachers" did on the exam.

In late October, the UW College of Engineering underwent a thorough review conducted by the Accreditation Board for Engineering and Technology (ABET). This review was a major step in the College's bid to continue as an accredited engineering school.

Engineering schools are reviewed once every six years, and UW was last reviewed in 1976. ABET chooses representatives from various professional societies and disciplines in industry to form an "accreditation team" for each of the different departments in the engineering college. For obvious reasons of impartiality, no one on the reviewing team can have any connections, either past or present, with the school involved. This includes administrators, faculty members, and past students.

A team of twelve reviewers, including the team chairman, visited the College of Engineering in October. A variety of materials were prepared for them beforehand, including sample homework, course syllabi, exams and transcripts of graduates.

While on campus, the team met with faculty members, as well as department chairmen and students at different levels of the various engineering programs offered here. An effort was made to obtain a random cross-section of the engineering student body.

Besides critiquing the engineering faculty and courses, the reviewing team must also examine corresponding courses and departments in Letters and Science. This includes mathematics, chemistry, physics, computer science, economics, and statistics. These courses must also meet ABET expectations because they are an integral part of the engineering student's education.

Following the review of the prepared materials, textbooks, and other information gathered from faculty members and students, recommendations are written for each individual program which is being reviewed. Reviewers offer suggestions for improvement, some of which are then required for accreditation, and others which are not necessary but which the reviewer thinks would be beneficial to the program.

Reviewers meet with the chancellor and the deans to discuss these recommendations. The review reports are then sent to the accrediting agency which makes the final decision as to whether accreditations should be granted.

According to Professor Frederick H. Buelow, Chairman of the Agricultural Engineering Department and a past member of numerous reviewing teams, reviewers look for a correct mix of courses, faculty members, and facilities which appear to work together to sustain a good program. "Ultimately, a graduating student [from an accredited program] will have a good engineering education that, in turn, interprets quantitative and qualitative factors."

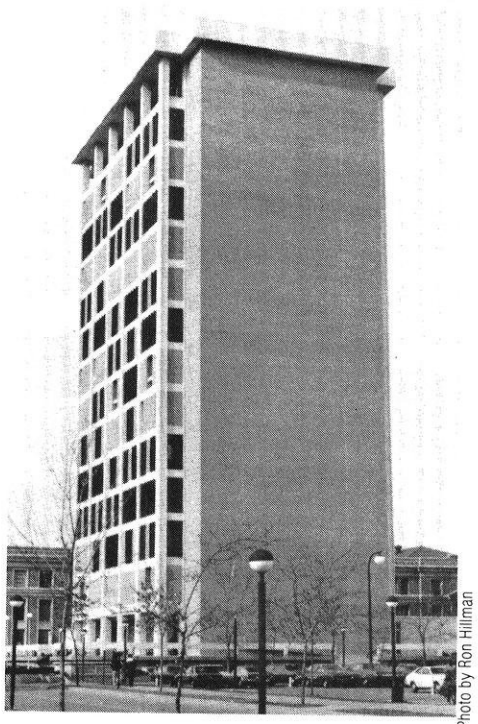


Photo by Ron Hillman

The Engineering Research Building was part of the scene this fall for an intensive review of our engineering college.

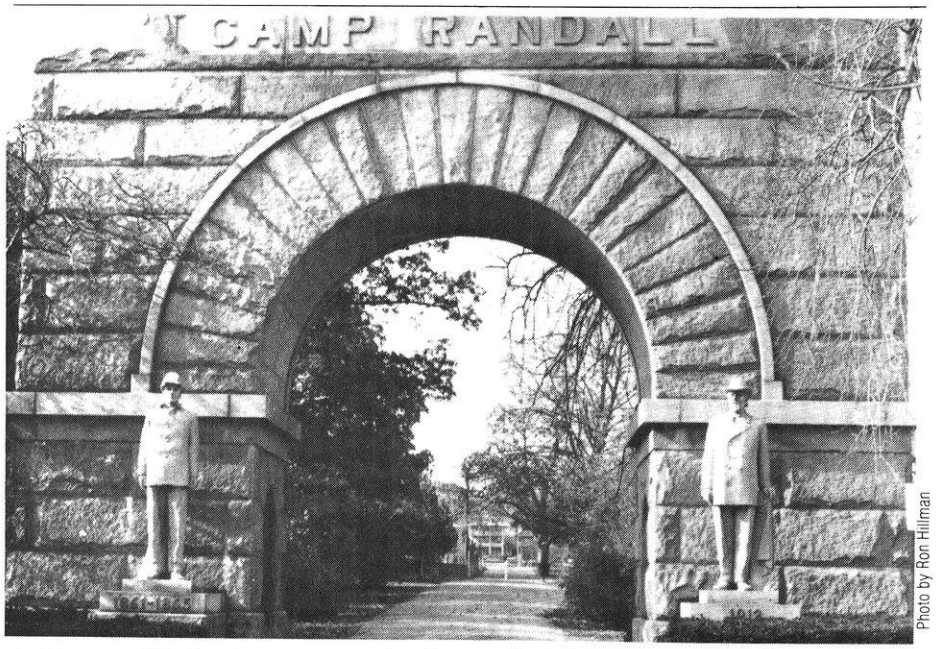


Photo by Ron Hillman

As the accreditation team approaches the engineering campus, this is one of their first impressions. Did the UW live up to its reputation?

The results of the ABET review are very important to the College of Engineering for many reasons. Accreditation means that the "instructional programs for degrees meet the standards of professional societies and industry," according to Assistant Dean Richard Hosman.

This is especially important to UW graduates. Graduate schools are able to evaluate a student's undergraduate education and possible course deficiencies more accurately if the school is accredited. Graduating from an accredited school is also a big plus when look-

ing for a job. Said Professor James A. Marks, director of the engineering placement office, "I don't think most companies would even recruit at a school that wasn't accredited."

Probably the most beneficial result of the ABET reviewing process is the recommendations made for improvement. The College of Engineering gains impartial advice from qualified engineers which they wouldn't otherwise obtain. In the past, for example, this has included the addition of social studies and humanities credits to the engineering curriculum.

The results of the review of undergraduate instructional programs are studied by the Dean of the College of Engineering, John Bollinger, and by the academic deans, department chairmen, and faculty members, who, in turn, also report to the chancellor. Often this causes changes to be made in areas that were in question prior to the review.

Although the results of the evaluation were not available at the time of print, they will be studied carefully by the College of Engineering and any necessary improvements will be made after such consideration. □

Software Saving Hard Money

by Scott Paul

Some researchers believe launching a Space Shuttle is easier than ordering office supplies by triplicate. But no more, says Scott Paul, as he reports on a new computer system developed for NASA.

The Ford Aerospace Communications Corporation is a Houston-based subcontractor for NASA. It is responsible for building and installing much of the electronic equipment that is currently flying on the space shuttle Columbia as well as for the other shuttles in production. At a time when NASA is pitifully funded in relation to other programs, it is critically important for companies like the Ford Corporation to maximize their productivity and efficiency in order to help NASA get the most use of their space-bound dollars. That's where Peter Huang comes in.

Peter is a senior at UW majoring in computer science. Last summer Peter worked for the Ford Corp. to develop an organizational system that helps engineers interact with other facets of the company more efficiently. What he did, specifically, was to implement a Database Management Program for the Engineering Preferred Parts list into a existing computer system.

The purpose of the program is to give engineers more rapid access to parts and equipment needed for building things, and to help them find the specific part that they need even when the engineer may not know the exact catalog number of the part he wants. These cumbersome tasks once were completed through the triplicate process now considered slow and inefficient.

The program is run on a VAX 11/78-computer programmed in C language, and consists of about 6000 lines of language code. However, at least half of the program consists of user-friendly help routines which help engineers, many of whom do not work with the computer on a regular basis, to find the parts they need fast, with a minimum amount of wrestling with the computer.

An engineer can call up a part by the manufacturer's part number, by catalog number, or by giving the computer a general description of the part and letting it find the part number for you. The computer then prints out a list of the desired parts. This list serves as a requisition form for the parts, thus saving the engineer additional time that otherwise would have been spent doing nonproductive pencil and paper work.

Time is money. And the innovative work done by Peter Huang and other bright young men and women saves millions of dollars each year by increasing efficiency and productivity within American companies. In Peter's case, most of the increased productivity comes as a direct result of new uses of existing computer technology. If, like NASA's space shuttle, we keep our productivity levels flying high, then American business will have that keen edge that it needs to compete effectively in the highly competitive world market. □

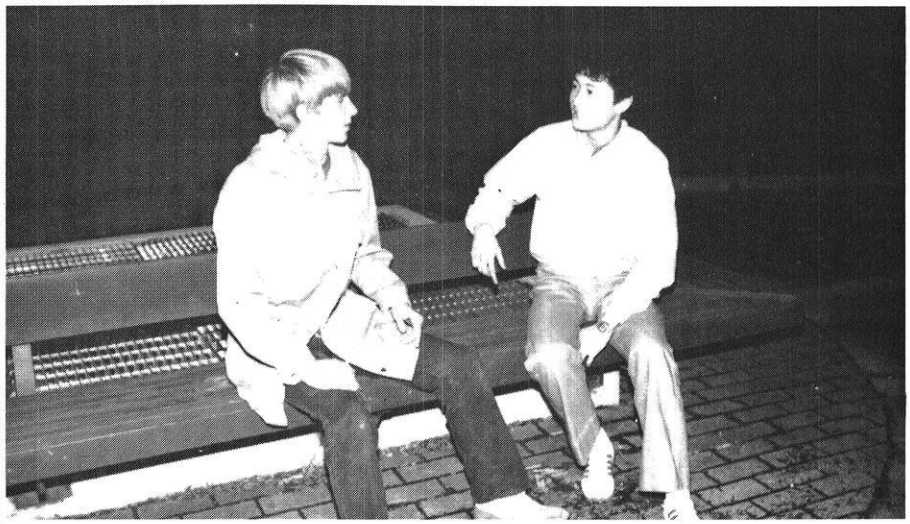
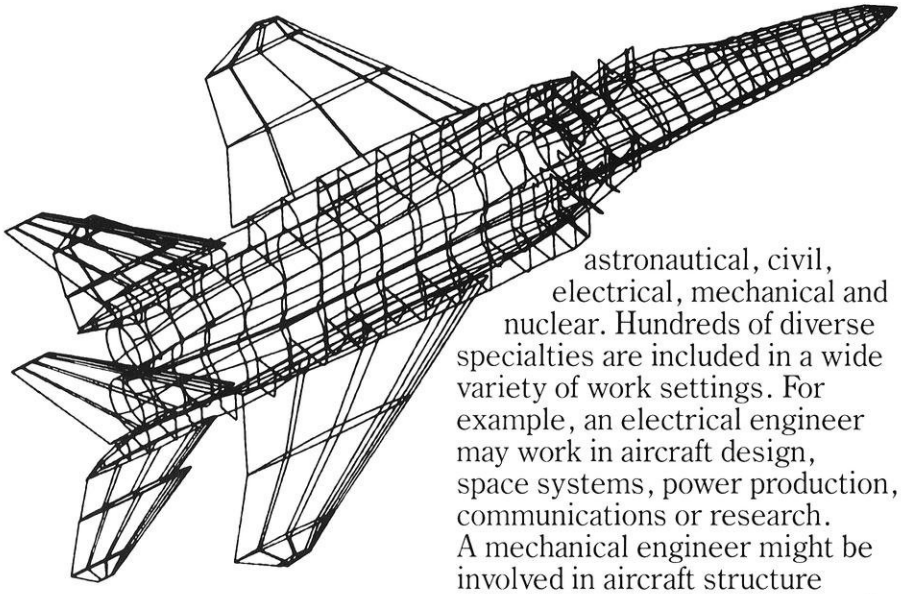


Photo by Fernando Perez

Journalist Scott Paul discusses the Data-base Management Program with its developer, Peter Huang.

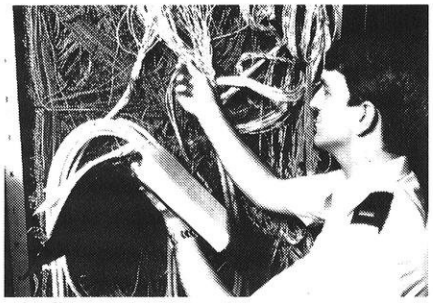
ENGINEERING TAKES ON EXCITING NEW DIMENSIONS IN THE AIR FORCE.



Computer-generated design for investigating structural strengths and weaknesses.

Developing and managing Air Force engineering projects could be the most important, exciting challenge of your life. The projects extend to virtually every engineering frontier.

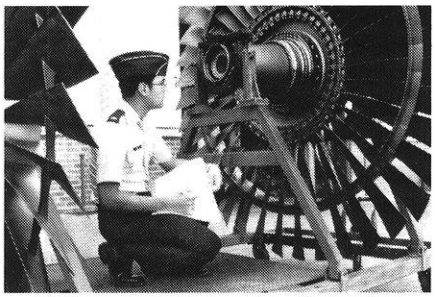
8 CAREER FIELDS FOR ENGINEERS



Air Force electrical engineer studying aircraft electrical power supply system.

Engineering opportunities in the Air Force include these eight career areas: aeronautical, aerospace, architectural, astronautical, civil, electrical, mechanical and nuclear. Hundreds of diverse specialties are included in a wide variety of work settings. For example, an electrical engineer may work in aircraft design, space systems, power production, communications or research. A mechanical engineer might be involved in aircraft structure design, space vehicle launch pad construction, or research.

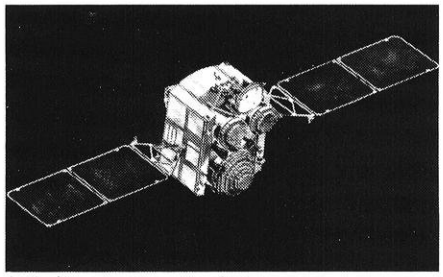
PROJECT RESPONSIBILITY COMES EARLY IN THE AIR FORCE



Air Force mechanical engineer inspecting aircraft jet engine turbine.

Most Air Force engineers have complete project responsibility early in their careers. For example, a first lieutenant directed work on a new airborne electronic system to pinpoint radiating targets. Another engineer tested the jet engines for advanced tanker and cargo aircraft.

OPPORTUNITIES IN THE NEW USAF SPACE COMMAND



Artist's concept of the DSCS III Defense Satellite Communications System satellite. (USAF photo.)

Recently, the Air Force formed a new Space Command. Its role is to pull together space operations and research and development efforts, focusing on the unique technological needs of space systems. This can be your opportunity to join the team that develops superior space systems as the Air Force moves into the twenty-first century.

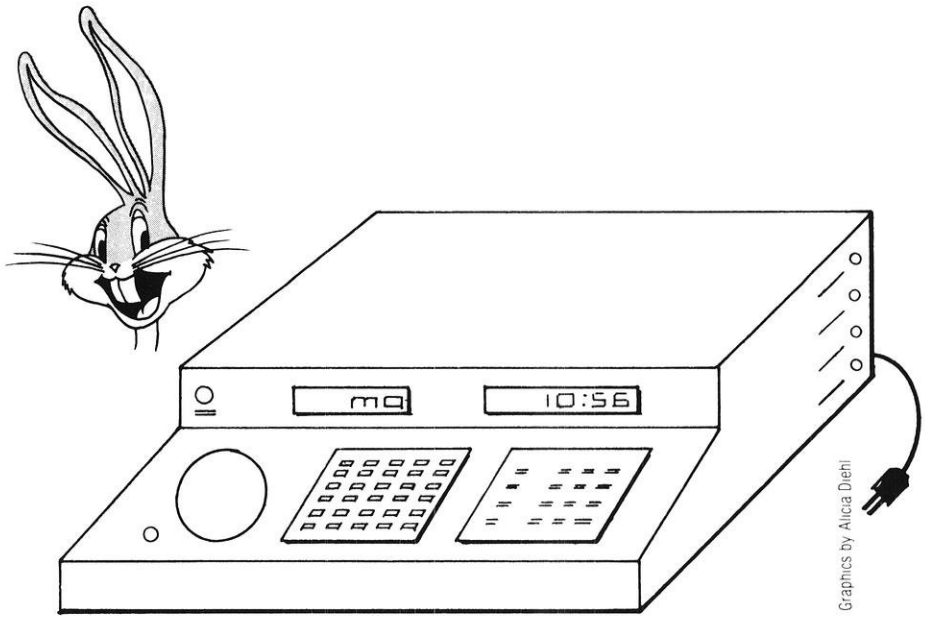
To learn more about how you can be part of the team, see your Air Force recruiter or call our Engineer Hotline toll free 1-800-531-5826 (in Texas call 1-800-292-5366). There's no obligation.

AIM HIGH
AIR FORCE

What's UPDOC?

by Jim Hull and Tim Rueth

Jim Hull and Tim Rueth are both electrical engineering seniors specializing in Computer Engineering. They are designing and constructing this project for ECE 453 Microprocessor Lab. It will also be exhibited at EXPO '83 this spring.



Graphics by Alicia Diehl

What's UPDOC? It's a Universal Programmable Device Outlet Controller--a Motorola 6802 microprocessor-based project being designed and constructed by Tim Rueth and Jim Hull this semester. Tim is concentrating his efforts on the hardware while Jim develops the software. However, a great deal of team effort has been expended on the overall system design.

UPDOC will control four outlets (110 VAC) and a speaker. Using 128 bytes of on-chip RAM (Random Access Memory), 1K (one kilobytes) of external RAM, and 4K of EPROM (Erasable Programmable Read-Only Memory), up to 220 nodes can be programmed to either turn on or off any of the five devices based on the current time. The user can mask (inhibit) any of the four outlets by a manual switch or a logic low (ground) input signal from a peripheral device. For example, let's say a motor is controlled by UPDOC to open a set of drapes at 7:00 a.m. and close them at 7:00 p.m. every day. If the sun is hidden by cloud cover, the drapes should remain shut, so a photosensor signal may be attached to UPDOC to prevent the drapes from being opened.

The information input is done by a touch-sensor keypad designed specially for this project. The finite skin resistance of the fingertip is sensed by circuitry which the microprocessor then acts upon. Each device can be programmed to turn on or off at a set time any day, or every day of the week. Each key is multifunction, meaning a key can assume different meanings depending on what the microprocessor is expecting. UPDOC is highly interactive and user-friendly. It asks the user questions instead of making him try to figure out what to key in next. Information is entered by 16 keys and UPDOC interacts with a four-character display for commands and a four-digit display for the time. The device status is also continuously displayed by small light-emitting diodes (LED's). They show whether each device has been programmed to turn on or off, the current on/off state of each device, and the mask of each outlet.

The time display can be dimmed by a control to prevent high illumination in a dark environment. The signal to each outlet can be chopped to allow a motor speed control, light dimmer, temperature control, and other applications. The speaker is a single-tone sound which, when enabled, oscillates on and off to act as a wake-up signal or a burglar alarm. The speaker volume can be controlled by the user.

How much will UPDOC cost? Latest estimates are approaching $200, but Tim hopes it will pay for itself if used wisely in the years to come. □


Photo by Ron Hillman

ECE seniors Jim Hull and Tim Rueth are designing a universal programmable device outlet controller to turn their appliances on and off. Here they adjust a few fine points in the layout for this 1983 Expo project.

The Dispersion Analysis

Exhaust dispersion near a roadway is influenced by the turbulence and heat generated by moving vehicles. Findings at the General Motors Research Laboratories have provided a new understanding of the dispersion process.

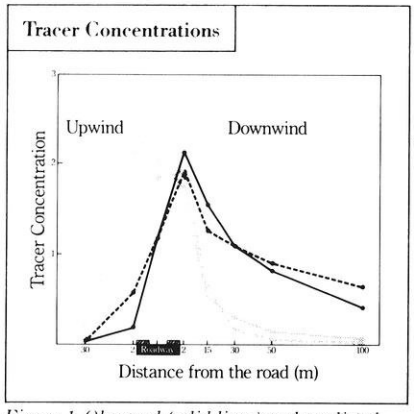


Figure 1: Observed (solid lines) and predicted (dashed lines) tracer concentrations near ground level as a function of distance from the edge of the road. Black lines indicate the case in which the wind is perpendicular to the road; gray lines, when the wind is nearly parallel to the road and opposing the upwind-lane traffic.

Figure 2: This representation of a roadway viewed from above shows the location of large vortices formed by local wind shear when the wind opposes the upwind-lane traffic.

BY USING the conservation-of-mass equation, one can describe the dispersion of gaseous molecules in the atmosphere. The equation includes terms for advection, diffusion, sources and sinks. Advection is the transport of air parcels by the mean wind; diffusion is due mainly to turbulent mixing. But the equation is useful only if we have information about the wind and temperature fields in the atmosphere. Specifically, our ability to predict vehicular exhaust concentrations near a road depends on knowledge of the effects of vehicles on these fields.

The conservation-of-mass equation for the mean concentration of any species, C, is

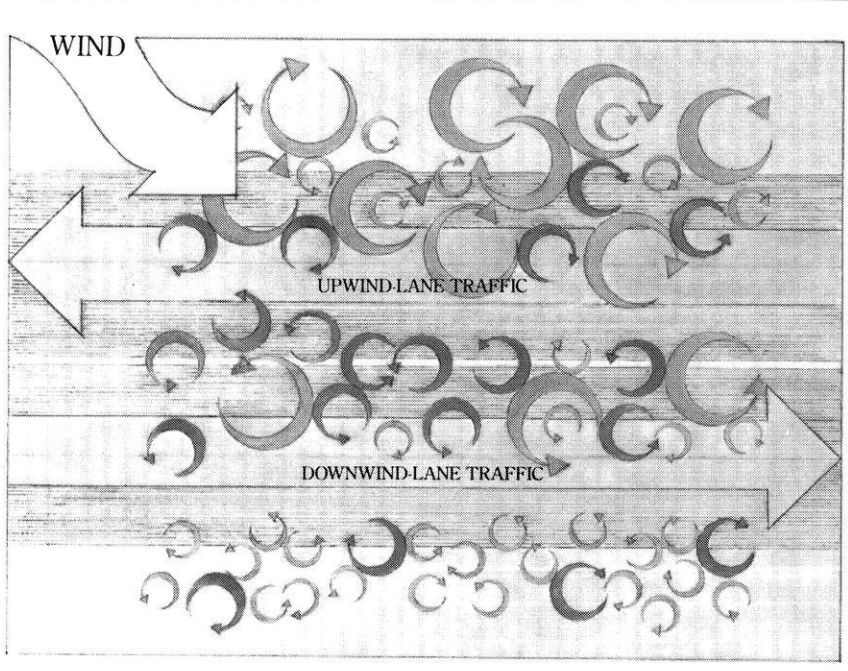
$$\frac{\partial C}{\partial t} + \sum_i \frac{\partial (U_i C)}{\partial x_i} = \sum_{i,j} \frac{\partial}{\partial x_j}\left(K_{ij}\frac{\partial C}{\partial x_j}\right) + So + Si$$

Local rate of change — Advection — Diffusion — Sources — Sinks

where U_i is the mean wind velocity and K_{ij} is the eddy diffusivity tensor. This equation applies when the length scale of mixing is small compared to that of the variation of the mean concentration. Near a road, this condition is met if the averaging time for the concentration and wind velocity is much longer than the time interval of vehicular passage. For a straight roadway, a long averaging time allows one to assume spatial uniformity in the direction parallel to the road, and to ignore the spatial derivatives in that direction.

The input information for K_{ij} and the mean crossroad and vertical wind components near a roadway became available as a result of a large-scale experiment conducted by the General Motors Research Laboratories. The experiment has provided an understanding of the influence of moving vehicles on mechanical turbulence and buoyancy near a roadway. Dr. David Chock was responsible for the design of the experiment and the analysis of the data. The experiment, which duplicated a heavily traveled, level roadway, was conducted under meterological conditions minimizing dispersion.

Moving vehicles affect the mean crossroad and vertical wind components in the following ways. Vehicles act as an obstacle to the mean wind, causing it to slow and move upward as it approaches the vehicles and downward as it leaves the road. In addition, vehicles release heat, which causes a net upward motion. It was established that the increase in the mean vertical wind component due to the exhaust heat was $(B/U)^{1/2}$, where U is the crossroad wind component.



The buoyancy flux, B, is proportional to the heat emission rate of the vehicles.

Moving vehicles also enhance both turbulence intensity and mixing. To determine how this modifies the eddy diffusivity tensor, K_{ij}, Dr. Chock invoked a "second-order closure" assumption, which relates eddy diffusivity to Reynolds stresses and the gradients of mean wind velocity and mean temperature. Eddy diffusivity was assumed to be the sum of ambient and traffic contributions. To determine the traffic contribution, the length scale of the traffic-induced turbulence was assumed to be comparable to vehicle height—1.5 m.

USING THE vast data base compiled during the experiment, Dr. Chock was able to specify K_{ij} and the mean crossroad and vertical wind components, and solve the equation numerically. To test the model, half-hour measurements of a tracer gas were used to map out experimentally the exhaust dispersion under various meteorological conditions. The case where the wind speed is low and the wind direction is nearly perpendicular to the roadway is represented by the black lines in Figure 1. Both the model and the experiment show the same dispersion pattern. The peak concentration is on the downwind roadside.

When the wind is nearly parallel to the road, the situation is much more complicated. Figure 2 shows that when the wind and traffic flow on the upwind lanes oppose each other, a high shear region occurs immediately upwind of the first traffic lane. When the wind and traffic are in the same direction, the high shear region occurs in the median of the road. In these high shear regions, large eddies are generated and turbulent mixing is intense. The gray lines in Figure 1 show a comparison of the model's predictions with the tracer data for the case illustrated by Figure 2. Notice that the peak concentration can actually occur on the upwind roadside, due to the exhaust transport by these large eddies. Dr. Chock's model is the first to predict this occurrence.

Under all combinations of wind speeds and directions, the predictions based on the model compare favorably with the measured tracer concentrations. There is little systematic bias with respect to wind direction.

"In light of this new model, exhaust dispersion near a roadway can now be predicted with reliability," says Dr. Chock. "This is of importance for environmentally sound road planning, and opens the door to the investigation of dispersion on city streets, where the presence of tall structures introduces even further complexity."

THE MAN BEHIND THE WORK

Dr. David Chock is a Senior Staff Research Scientist in the Environmental Science Department at the General Motors Research Laboratories.

Dr. Chock received his Ph.D. in Chemical Physics from the University of Chicago. His thesis concerned the quantum mechanics of molecules and molecular crystals. As a Postdoctoral Fellow at the Free University of Brussels, he did research work on the dynamics of critical phenomena. He did additional postdoctoral work in the fields of solid-state physics and fluid dynamics.

Dr. Chock joined the corporation in 1972. He is leader of the GM atmospheric modeling group. His current research interests include the phenomena of atmospheric transport and reactions, and the statistical study of time-series data.

The Interviewing Game

by Mike Reiels

Each year, engineering seniors must learn the tricks to having successful interviews. Fortunately, Mike Reiels has saved them the time and trouble in recording the trials and tribulations of one John Smith. Mike had to follow John Smith because Jane Jones was away on a plant trip.

John Smith, a senior in engineering, has another interview today. He is finally getting a chance to talk with the company he's been waiting for all semester. John, wearing his Levi's and flannel shirt, heads for the bathroom with his garment bag over his shoulder. He emerges from the bathroom as Mr. Professional, sort of like Superman coming out of a phone booth. On his way to the placement office, he runs into his friend, James Underclassman. James, impressed by John's suit and professionalism, comments sarcastically, "Boy, it must be rought to just sit and look pretty while the rest of us go to class!" John laughs it off, but knows that James doesn't realize how much work goes into interviewing if it's to be done right.

John's job-hunting process started last spring when he had to put together his college interview form. Although much of the information required is pure fact, some creativity must be used to present the rest of the information. Probably the hardest item to successfully compose is the job interest summary paragraph, usually because the student's hasn't given the topic much thought.

Then, last summer, John spent a good deal of time searching for his interviewing suit. He finally bought a conservative dark blue one at a finer men's store in town. By the time he bought the shirt, tie, and shoes to go with it, he figured it cost him about 100 pitchers at Jingle's.

Finally, John had to spend time researching the company. He knows how important it is to have some knowledge of the company and its products, and to be able to ask the recruiter intelligent questions.

Well, James had left and John is walking up the stairs to the interview rooms. John stops at the top of the stairs, looks in the mirror and checks his hair, tie, and suit. He notices the sign above it that states, "You'll never have a second chance to make a first impression." The first impression of a candidate the recruiter gets is the most important. John takes a seat in the waiting room. Finally the recruiter steps out of his room and calls John's name; the interview has begun.

As John walks over to the recruiter, the recruiter takes note of his posture, stride, clothing, and briskness. The recruiter greets John with a firm handshake and John reciprocates. As he walks past the recruiter into the interview room, the recruiter takes a closer look at John's hair, collar, back, pants, and shoes. John knows this "inspection" is common recruiter practice, so he has made a point to look impressive. The recruiter has already read John's interview form and formed some sort of an opinion before they even meet. Before any questions are even asked, chances are that fifty percent of the decision whether or not to recommend John has already been made.

The heart of the interview now begins. John has had quite a few interviews. He knows what the recruiter is looking for. He asks pertinent questions and shows enthusiasm; he doesn't let his butterflies bother him. Nothing squelches enthusiasm faster than nervousness. Although John is still a student, he must act as a professional; the recruiters look for professionals, not students. Finally, John capitalizes on the pressure the recruiter is under. Anyone the recruiter recommends is a reflection on his judgement.

"You'll never have a second chance to make a first impression."

If he makes a poor recommendation, he'll hear about it from his boss or the department that ends up with the new employee. At the same time, the recruiter can't reject everyone; his job is to find people to fill company openings.

John feels he has been successful in selling himself to the recruiter. He has done his best to make it hard for the recruiter not to recommend him. John

continued on page 22.

Interviewing is the art of packing four years of college into a first impression.

Cryogenics: A Chilling Recycling Method

by David Eiche

A new process for recycling rubber tires has been developed in our Mechanical Engineering Department. A sophmore in M.E., David Eiche visited the research lab and submitted this report of the project's progress.

Every year, over 200 million tires are discarded in this country. These seemingly innocuous items represent a tremendous environmental headache because they cannot be disposed of by conventional means. It is illegal to burn tires openly, and if buried, they will not decompose and may later reappear on the surface due to pressure from below.

A solution to this problem and many others lies in cryogenic recycling, a means of recovering materials by subjecting them to impact at very low temperatures. This process is familiar to anyone who has dropped a seemingly durable plastic object on a cold winter day and found that it broke upon impact. Cryogenic recycling works on a similar principle, except that the processing temperatures are much lower and the impact forces are greater. True cryogenic temperatures are reached with the use of a refrigerant to bring the temperature down to -50 C or lower. Liquid nitrogen is used because of its low boiling point (-196 C) and reasonable cost. Since it is a liquid at cryogenic temperatures, heat is efficiently transferred out of the material to be cooled.

The secret of cryogenic recycling lies in the fact that many materials which are ductile at usually ambient temperatures will become brittle when cooled to cryogenic temperatures. They are then easily fractured to recover the material for use in new products. One material group instantaneously becomes brittle at a specific temperature. This temperature is influenced by both the shape of a given sample and its molecular characteristics. Other materials gradually grow more brittle as temperature decreases. A third group remains ductile at very low temperatures and therefore cannot be processed using this technique, since such materials will yield or deform before fracturing. Materials in the other two groups can be cryogenically processed if their resistance to fracture is sufficiently low. A fracture toughness of 10 ft-lb or less is considered satisfactory.

Different materials within objects can often be separated and recycled if the components become brittle at different temperatures. The technique used to recover such materials is called selective embrittlement. Plastic-coated copper wires can be effectively recycled using selective embrittlement, since the copper remains ductible at the embrittlement temperature of the plastic. Thus, both the copper and the plastic can be efficiently separated and reused. Selective embrittlement is used in a variety of automotive electrical parts, including the starter, alternator, and electric motors. The parts are cooled to the embrittlement temperature of one of the components and fractured by the impact of a hammer. The ferrous materials can then be separated out magnetically.

The construction of steel-belted tires also lends itself well to this type of processing because the belts can be easily separated from the rubber. In fact, cryogenic recycling is the only way known to process belted tires. It is also advantageous for recycling tires without belts, since the process is practically pollution-free. Combustion, the alternative, produces noxious fumes, while the former method leaves the rubber available for reuse. For example, the flexibility and strength retention of asphalt can be enhanced by adding rubber.

Researchers have found a number of novel applications for cryogenics. Many foundries now use a cryogen to cool castings and facilitate cleaner separation of molds. The food industry uses similar processes to remove the corn kernels from the cob without losing nutritious components. A process was developed here at the UW whereby often wasted hog hide is made suitable for use in leather products. In the past, hog hide required soaking to remove unwanted hair; this process often ruined the hide. In the new cryogenic process, hog carcasses are cooled to -90 F at which the hair simply crackles off, leaving the hide in good condition.

A leading proponent of cryogenic recycling is Professor Norman R. Braton of the Mechanical Engineering Dept. who has presented a number of papers on the subject. Prof. Braton has already found considerable commercial interest in the process. This is not surprising considering that the need for an efficient, pollution-free recycling process has never been greater as raw materials become progressively scarcer and refuse continues to accumulate. For example, only 10% of all the tires ever produced have been recycled. This is especially wasteful as the price of raw materials for new tires has risen.

The College of Engineering operates its own cryogenic recycling lab in the Mechanical Engineering Building. Tires

continued on page 23.

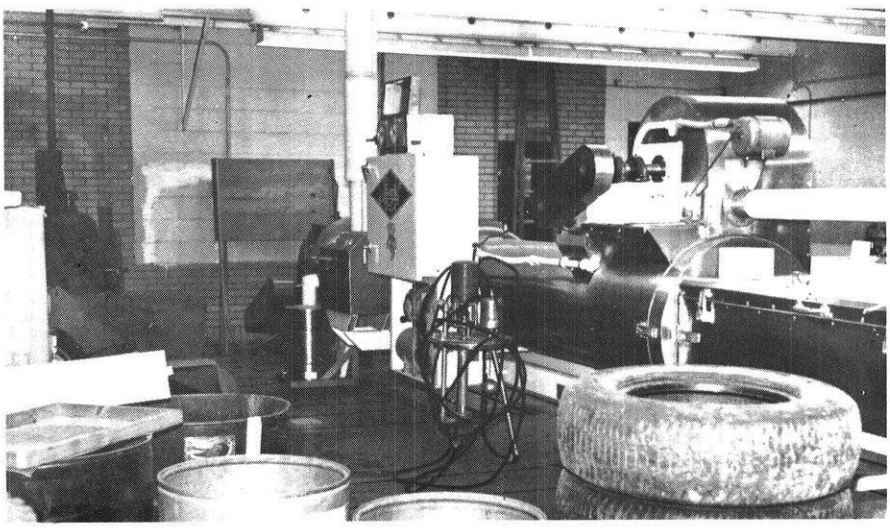


Photo by Ron Hillman

After a life of service, a tire's dreams of a standard junkyard retirement are soon shattered and shoved into charboard boxes in Dr. Braton's lab.

An Engineer Looks at Economics

by Robert A. Clark, Jr., EE'23

Mr. Clark graduated from the UW with an Electrical Engineering degree in 1923. Since then, Mr. Clark founded and now heads the Ceeco Telecommunications Company in Plantation, Florida. We are pleased to welcome his views from a different perspective.

In the summer of 1935, I had the rare opportunity of spending six days with Paul Darrow listening to his views on economics. We drove from Chicago to Alabama and Mississippi to inspect some Telephone properties owned by the South States Utilities Company then in receivership. Mr. Darrow had been asked by Judge Barnes in Federal Court in Chicago to inspect the properties and evaluate the possible salvage. Born in 1883, Paul was the only son of the famous Clarence Darrow, probably best known for his involvement in the famous Bobby Franks murder trial in 1923 and the Scopes evolution (monkey) trial in 1925. He was more a philosopher than his father, although little of his theories were published other than a monograph in 1941 covering his appearance before a special committee of the House of Representatives investigating destitute citizens.

Interspersed with stops along the way looking for bits of civil war history, we three, Mr. W. A. Duncan, Vice President, Mr. E. F. Grundin, attorney for the company, and myself, listened to a theory of economics which I never heard before or since. After more than forty years since that memorable trip, I am convinced the theory is valid and that the country has been following the philosophy of Mr. Darrow substantially as he outlined it during our six-day discourse.

The Philosophy:

The people of these United States may be divided into three categories: (1) The idle rich, (2) The idle poor, and (3) The working class.

Mr. Darrow defines the idle rich as those who can live comfortably on an income from savings or investments. The idle poor do not have such income. The working class comprises those who want to be productive and enjoy the profits from their labor.

To have a stable economy, it is only necessary to provide the opportunity for those who want to work. It is essential, however, that our government takes it upon itself to provide this opportunity.

As Mr. Darrow expanded his philosophy, Mr. Grundin asked, "Do you mean than, if necessary, the government should provide jobs to make matchsticks and then throw them in the ocean?" Mr. Darrow replied, "Yes, if necessary, but there can be found other work that will be more beneficial to the people".

I believe, like Mr. Darrow, there are sufficient people who will work to provide adequate manpower for the needed requirements of a healthy economy. Perhaps we are giving the poor too much, thereby placing fewer people in the working category than necessary to maintain a proper balance.

Shortly after the time of our trip, the U.S. Government started programs along the lines of Mr. Darrow's philosophy. The WPA was instituted. Unemployment benefits were developed, as well as Social Security, the first for the poor, the second to make retired people the unemployed "rich".

Then the war came, after which the system worked very well. Disabled veterans and those who could not work joined the unemployed rich. Social Security company pension plans took care of the elderly. By the large the program is working quite well today. The idle rich are with us, increasing in numbers each year. It is true some are hurting due to inflation but increases in Social Security have eased the pain. Many others have sufficient income so that price increases have not hurt their standard of living.

What has happened to disrupt the program? Several factors have developed which Mr. Darrow probably did not foresee. One, we are a little too generous with our idle poor. Secondly, the labor rates of our working class have become unbalanced. Inasmuch as our success in life depends on world trade today, our labor rates must keep somewhat in line with other countries. After all, wages only function in our ability to obtain goods and services we want. If the price of goods in one category (autos, for example) become excessive due to the higher than normal labor rates, others in a lower labor bracket will be unable to buy the product and that item will be priced out of the market. Ultimately, this problem will be corrected, but in the meantime, our economy suffers. Thirdly, I believe Mr. Darrow thought only in terms of the economy within the United States. He did not envision the extent of our "give-away" programs to the world.

Our banking system may be partially at fault for this condition, also the greed of some of our capitalistic merchants. These people put pressure on our bankers to loan money to foreign neighbors without regard to how the money could be paid back. Merchandise was thus sold at inflated prices, so that our people were deprived of goods they needed and

Creative energy programs are needed to give our economy a boost. These programs should be for those shown here. Located above the ERB is the ECE Dept.'s wind turbine, and parked below is a research electric car.

Photo by Ron Hillman

could have obtained at reasonable prices.

It is nice to argue that by giving a thousand tractors to Ethiopia we provide work for the men who manufacture farm equipment. But by sending our resources out of the country, we have deprived our farmers of a product at a price they can afford to pay. Result: inflation. The trend toward correcting this problem is starting. We must keep alert to see that the "special interests" who promote give-away programs are kept in rein and the results of our efforts are kept at home where they are needed. Only when our needs are satisfied will we be able to give products away to foreign neighbors no matter how badly they may need them.

Can we correct our problems and swing the economy back on the path Mr. Darrow predicted? I am optimistic and believe we can. What should our goals be? I think we should think first of the requirements of the working class and the idle rich. I do not, and neither did Mr. Darrow, believe we can give the idle poor all they would like to have. That would give them too great an incentive to be idle and increase their numbers beyond the ability of the working class to support them. Mr. Darrow, in his testimony before the House of Representatives (the monograph dated January, 1941), suggested $20.00 a month for a single person, $15.00 extra for a wife and $10.00 for each child. He thought, "This might be too much. Twenty dollars a month would not eliminate those of productive age because their wants would be satisfied."

"We must set our country up economically as a business; on one side our assets, on the other our liabilities."

Today, we are violating this principle in that we are giving the idle poor so much that they are satisfied with life. Referring again to Mr. Darrow's philosophy, we must provide a job at a reasonable wage for everyone who wants to work.

Rep. Paul Simon (D-Ill.) recently said it very well:

> "More than four decades ago, we rejected the idea that if people cannot find work they should starve. Now we face the choice of either paying people for doing nothing or paying them for being productive."

With the ingenuity of the American people, I believe there are enough who want to work and supply the needs of the idle to provide prosperity for all. Those who want to work should include all who wish to even though they have reached the so-called "retirement age". There are many whose sole desire in life is to make contributions even though they have no financial need. They should not be hindered in this desire; they contribution will be of inestimable value.

Finally, how are we going to carry out Mr. Darrow's program? Here is where my views are in conflict with age old economic theory.

Our monetary system is obsolete and must be improved. President Roosevelt thought so when he took the country off the gold standard. Perhaps this was a start, but he did not go far enough and we need to make further changes. Our concept of that trillion dollar debt must be changed. We must set our country up economically as a business; on one side our assets, on the other, our liabilities When this is done, the trillion dollars will not look so formidable.

Let us set up a simple balance sheet and see where we are. Feeble suggestions along these lines have been made from time to time. In 1965, Senator Russell B. Long (D-La.) said, "The way the government does its bookkeeping, you just throw everything into the debit side. You don't even count your assets".

Table 1 shows my estimate of the country's wealth. The figures are based on collection of data obtained over the years and are, I believe, conservative:

TABLE I
ASSETS $1 BILLIONS

Item	Depreciable	Non-Depreciable	Total
Land		772	772
Tangible Property	10	67	87
Buildings	870		870
Power Systems	120	24	144
Highway	60	21	81
Waterways	93	24	117
Military	450	12	462
Aviation	60	6	66
	1663	926	2599

It may, however, be necessary to change our capitalistic thinking somewhat. Today our national debt is getting beyond our ability to pay the interest charges. We can change the present concept by using the nation's capital wealth as backing for our money. This is like going back to the gold standard except that all of the nation's capital wealth forms the backing for our money. As shown in Table 1, our assets clearly exceed our national indebtedness. Our

continued on page 20.

The Never Changing Economy

Two years before the turn of the century, George Graham recorded the following words of wisdom on a Gram-o-phone.

> "Fellow citizens, we are congregated here this evening to find out what we know. Now there is one thing I am glad of, that in this country every man is entitled to his say and the women will have their say whether they are entitled to it or not. Now I speak this evening not in a theoretical sense, but in a practical way; the subject is entirely foreign to me. Where has all the money gone to? Who's got it? I'm sure I haven't got it and I know the women can't get away with all of it. They can get away with four-thirds of it and we get what's left. Some say one party got it and some say another. Now, what is money, my friends? If a man saves money, he's a miser; if he spends it, he's a spendthrift; and if he loans it, he's a fool. Now what are we going to do about it? Money is the cause of all the misery in the world and yet every man you meet is ready and willing to borrow trouble.
>
> Now the financial situation in this country is something frightful. We don't know whether we are going to have the gold standard or the silver standard. We don't know whether the dollar will be worth eighty cents, seventy cents, or sixty cents. The way I will get rid of the difficulty is this: Every dollar I get hold of I spend. I take no chances; the Government can bust tomorrow and it don't owe me a cent. The Democratic Party says the Republican Party are all thieves and the Republican Party say the Democratic Party are all thieves. Well then, they know each other very well.
>
> Not if you want to end this contention and strife, give me my way - Make me President of this United States, and in one hand I'd grasp the American flag, the immortal stars and strips, and in the other I'd have a two-pound hunk of limberger cheese, and I'd climb to the highest summit of the Rocky Mountains. While standing upon the highest pinnacle of success, I would say, 'Downtrodden fellow people, the hour of deliverance has come, hog jowls and liver are down to six cents a pound'." □

Sticks in Spokes

(cont. from page 6.)

Trek, often called the "American Wonder of the Decade," is also misleading, since the only American thing about Trek bicycles is their Imron paint. Trek also has a certain European touch since it uses advanced technology and plant facilities that resembles foreign competition's techniques.

Though Schwinn and Trek have their place in the custom market, most U.S. manufacturers have concentrated on mass merchandising. Until recently, bicycles in the U.S. have been associated with "toys" for children, since adults already had their own, namely automobiles. The idea of using bicycles for transportation had not yet been impressed upon the average citizen. Thus U.S. manufacturers such as Huffy Corp., Murray-Ohio and others were primarily interested in tots and juveniles and saw little need for quality "adult" bicycles.

The retail stores such as Sears Roebuck, Montgomery Wards and discount houses also do not overly concern themselves with the quality of bikes they sell. They use bicycles and other related items as a means to draw customers into the store in hopes to make greater sales in the store's other more profitable areas.

When the bicycle boom of the seventies created a market for "light-weight 10 speed bikes," U.S. mass bicycle manufacturers found it difficult to get out of first gear. Though they fell way behind in the custom market, U.S. firms have improved the quality of both their custom and mass merchandised bicycles. American companies are now, perhaps for the first time, attentively listening to the want and needs of the public. To attract more adult buyers to their mass distribution centers, Murray-Ohio and the Huffy Corp. are adding higher-priced models to their lines. U.S. firms are also doing what some believe they do best by making cooperative business deals to remain solvent. Murray-Ohio has agreed to assemble 300,000 plus Schwinn model bikes a year. This deal gives Murray-Ohio more work while allowing Schwinn to concentrate on making some of the parts. A similar agreement has been made between Huffy Corp. and TI Raleigh.

So if one has reservations about purchasing a foreign made bicycle because it will hurt the U.S. economy, dismiss them immediately. Chances are that bike will possess enough imported parts to be considered an import. But, it is hoped that in the future that the U.S. bike companies can rival foreign firms as the international sport of bicycling becomes adopted as a national activity. □

Engineer's Library

"The Tao of Physics" A book written by Fritjof Capra

reviewed by Sara Rottunda

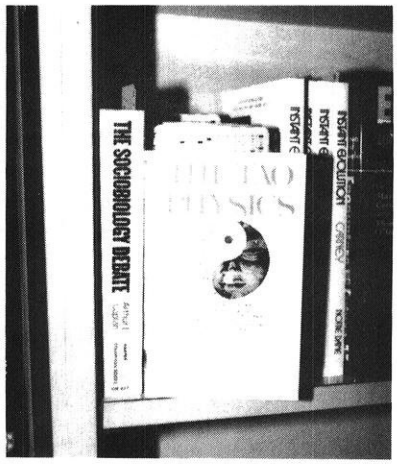
Both the scientist and the eastern philosopher seek patterns of thought that connect different events in nature. The scientist conducts experiments to collect data, while the philosopher undertakes the rituals of Hinduism and Buddhism to discover new information. Both seek a "unity of knowledge" to answer questions put to them. Though they seem contrasting at first, the scientific and philosophical methods share noticeable parallels when one looks for a unity between them.

One of the books that has been written on this subject is "The Tao of Physics" by Fritjof Capra. The author deals in particular with the relationship between modern physics and ancient Eastern religious philosophies. This combination should not seem surprising considering that inquiries into physics began in sixth century Greece, an atmosphere where scientific philosophy and religious philosophy were united.

Both science and religion are concerned with its "participation" in concepts and practices. In an experiment, a scientist measures the results of an event. Modern experimenters have come to realize that their presence actually affects the event, and therefore consider themselves as participants rather than mere observers. The mystic, in the same way, realizes that his existence participates within the total environment. Through meditation, a person can surpass the borders that extend between his "own" existence and the "one", all encompassing universe.

Mystics view "unity" as the interaction between experience and environment. Similarly, physicists have found that matter is comprised of the interaction between sub-atomic particles and the systems they exist within. It is this similiar "interconnectedness" that gave rise to the concept of "space-time continuums". This scientific concept of unity theorizes that every point in space-time is somehow connected to another.

The contrasting Yin and Yang, science and religion, are different methods of stretching the boundaries of the human mind. Though the eastern mystic and the western physicist will never completely meet eye-to-eye, we should realize that both of their systems of thought are vital to understanding how the world functions. The scientist who views the universe as fragmented rather than as an incorporated whole is failing to follow the direction in which both schools of thought lead. □



The Yin-Yang symbol on the cover this month symbolizes a new way of thinking about the interaction of productivity and design. Yin and Yang are the ancient Chinese principles of negative and positive, receptive and aggressive, dark and light. Like the poles of a magnet one cannot exist without the other.

In designing technological systems it is important to consider that human interaction with the system is built in. Some people feel that technology as a whole is dehumanizing. In the ideal system this would not be so, but instead the system and the human user would interact without domination of the machine over its builders. □

(cont. from page 17.)

money should be increased and the national debt reduced in conformity with our national assets. Fixed assets such as land need not be depreciated. Reserves should be set up for depreciables.

New capital investment should be paid for in dollars, not interest-bearing notes. When land is purchased for a bridge, airport or road, it is a non-depreciating asset and should be paid for with dollars from the U.S. Treasury. This is not inflation as some economists may say. They could just be wrong. We simply cannot go on expanding our economy to meet our needs borrowing money to do it.

In the past, the word "Technocrity" has crept in. The thinking was that our technical ingenuity has led to elimination of jobs to the point where there would be an oversupply of workers. I do not believe this could ever occur. There are so many new developments in the works that we will never run out of projects.

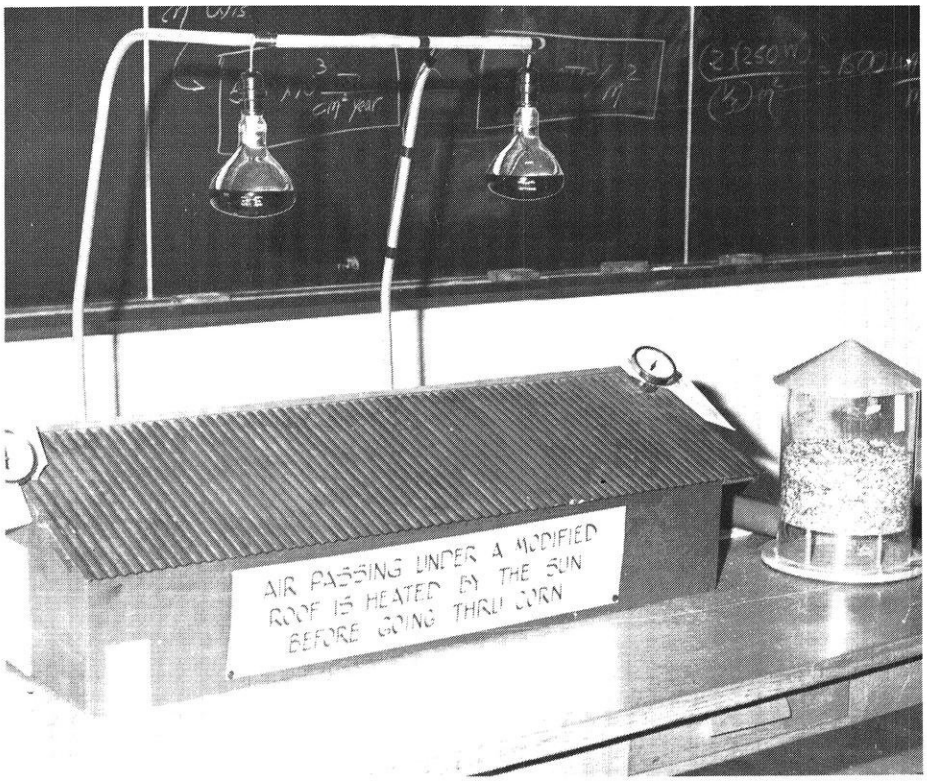
A good example is Chicago's new deep tunnel system now under contruction. This has become needed because of our captialistic growth, new communities, shopping centers and factories. The tunnel would be difficult to pay for by local taxes, and why should it? We have here a national asset which will last for centuries, the same as a flood control dam.

Likewise, when we build an interstate highway, we are creating a non-depreciable asset valuable to the country for decades. In my opinion, this highway is just as good backing for our currency as a block of gold in Ft. Knox. We will continue to need highways, and they should be built when we have manpower available.

This brings up the subject of energy. Undoubtedly the oil cartel triggered some of our economic problems, however, only in part. We were headed for trouble long before the days of the cartel. Oil and gas requirements can be greatly reduced. Much has been said about solar energy. In my opinion, direct conversion of solar energy is still in the future. However, the most efficient use of the sun is via the farmer. We are now ready to convert the sun's power into heat and motive power at high efficiency via crops such as corn, soybean, sugar cane, artichokes and even cat tails. Two and one half gallons of alcohol can be extracted from a bushel of corn, leaving more digestible nutrients than is fed to cattle initially. Methane gas can be produced from manure in the amount of 35 cubic feet per cow per day. From a dairy herd of sixty cows over 2,000 cubic feet of methane gas can be produced daily. A combination of the two will make a dairy farmer selfsufficient so far as energy is concerned.

Farmers need some help technically and financially; here is where the government can help by setting up an organization such as the REA to help get the program under way.

The future is bright; we must get our workers working. There are plenty of projects waiting - highways, rapid transit, water works, sewage treatment, polluction control. We need a little government assistance; the time is now. □



Passive solar energy can be used by the farmer to trim down energy costs, as exhibited by this past EXPO project.

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"Interviewing - The Game"

(cont. from page 14.)

leaves the interview room grinning as another interview is over. He now has a new reason to run to the mailbox in anticipation of the company's response.

John, like the rest of the graduating engineers, has a better edge in the job market than many students in nontechnical fields. As stated in a recent *Wall Street Journal* article, "Recent college graduates, especially those with degrees in engineering, computer science, and other technical fields, are still being recruited for entry level positions. 'Companies don't want to make the same mistake they made in the 1974 recession when they stopped hiring entry level people and then found themselves shorthanded when a recovery occurred,' said Mr. Charlson, manager, vice president, and senior partner of Korn/Ferry International." Even though times are tough, students are still getting jobs. According to Professor James Marks, director of the Engineering Placement Office, "Companies are still hiring, but they are being more selective. The competition between companies for the top students has increased quite a bit."

Madison engineering graduates are lucky to have access to this placement office, which is one of the finest in the nation. The office is extremely well organized and efficiently run to make interviewing as easy as possible for the graduating students. Also, the career orientation class offered in the spring of each year helps a great deal to prepare students for interviewing.

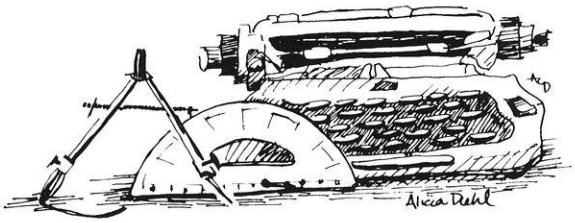
Taking a step back to look at the interviewing process, some things seem rather ironic. First off, probably the most important step in an interview is making a good first impression. Where did you learn to make good first impressions? Your mother? Bars? Chances are first impressions weren't stressed in most, or any, for that matter, of your engineering classes. Yet the first impression you convey to a recruiter can make or break you. Secondly, even though you've spent the last four or more years of your life punching calculator buttons and trying to figure out formulas, the interview itself will usually be very non-technical. It hardly seems fair. Finally, studying teaches about engineering whereas extra-curricular activities teach about people. Ironically, your degree will only qualify you for a job, but it will be your ability to deal with people that will land you a job. □

(cont. from page 15.)
and nonferrous cables are among the materials recycled in the lab. Lab equipment includes materials handling devices, cooling chambers, fragmentation mills, and the latest in instrumentation. Unfortunately, equipment designed specifically for cryogenic reprocessing is not available, despite the interest shown in it. Specifically designed equipment would result in more efficient processing because cryogenic reprocessing consumes only 10% of the power normally needed to recycle materials under ambient conditions. For example, entire automobiles are processed cryogenically in Belgium with 300 horsepower; a similar operation would require 3000 horsepower under ambient conditions.

With sufficient investment in research and development, inefficiencies in cryogenic recycling such as this could be eliminated. This method of recycling has proven to be a viable, practically pollution-free way to mitigate the problem of waste and the shortage of raw materials. Cryogenic recycling is indeed an idea whose time has come. □

The author wishes to thank Professor Braton for his help in the preparation of this article.

Bits & Threads



The Library of Congress is teaming up with NASA in a experiment aimed at halting the decay of books. The paper used for printing is usually treated with chemicals to enhance the print. Sooner or later, though, the chemicals turn to acid which makes the paper crumble. The Library's collection—the largest in the world—is threatened by the decay of acidic paper.

Currently, at the Goddard Space Flight Center, the library is experimenting with a space age fix. NASA has a huge vacuum chamber there and has been cooking 5000 volumes in a chemical gast to remove the acid. By 1985, the library wants to build its own factory that can take page-crumbling acid out of 500,000 books a year.

--The Wall Street Journal

Two outstanding engineering students have won the prized Tau Beta Pi Laureates Award for their accomplishments in liberal studies, public service, and other non-technical activities. Rhodes scholar and World Class sprinter Molly Brennan of Michigan State University, and Verne Harnish, a campus leader, Latin student, and entrepreneurial whiz at Wichita State University, will receive the $2500 prize at the society's 77th annual convention in Moscow, Idaho.

Concerned by the growing tendency of today's college students to concentrate on pre-professional studies without exploring the multiple facets of liberal culture, Tau Beta Pi set up the Laureate Award Program at its 1981 convention. The award will be a step toward fostering a "spirit of culture" among aspiring engineers by recognizing those who already have a well-rounded "Renaissance-spirit."

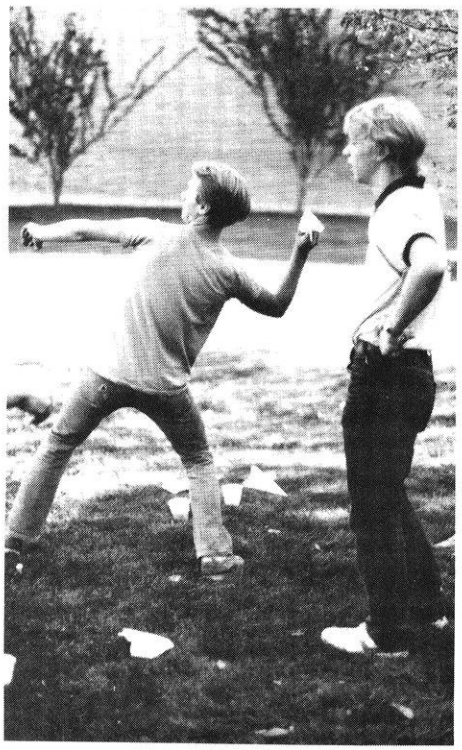
--TBP News

Investing in energy efficiency improvements can save small businesses in Wisconsin an average of 25 percent on energy use and yield a higher rate of return than investments in the business itself. That conclusion was reached by the Wisconsin Division of State Energy after reviewing the results of a recent study conducted for that office by the Wisconsin Power and Light Co., Madison, WI. --CUB News

By mandate of a state law enacted in 1979, the State Department of Industry, Labor and Human Relations has until January 1, 9183, to develop the efficiency standards and certification standards for rental unit energy inspectors. They must also develop the administrative details needed to enforce the standards.

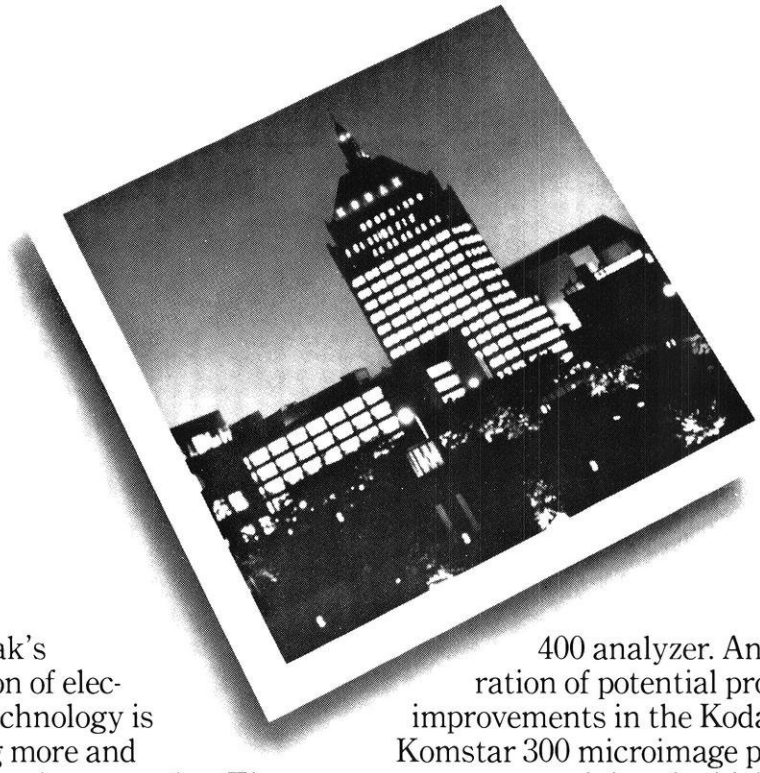
The law states that owners of apartments and rental homes must install insulation, storm windows and doors, caulking, weatherstripping, heating equipment improvements, hot water conservation devices and moisture controls, if costs can be recovered within five years. After January 1, 1985, no owner may transfer title to a rental unit unless it meets the department's energy efficiency standards and the building is certified by an inspector, or unless the new owner promises to make the building meet the standards within one year.

--CUB News



At the 6th Annual IEEE "Fly-in" contest, students skipped the shop drawings and folded their design paper into airplanes. Interest in this yearly even has grown exponentially since its beginning.

One of the nation's top companies in sales of electronics-related equipment is Kodak.



Kodak's application of electronics technology is becoming more and more extensive every day. That means we have growing career opportunities for electrical/electronics engineers.

In projects as diverse as the design and production of output driver chips for the logic and control unit of Kodak Ektaprint copier-duplicators. Development of advanced analog and digital technology and sophisticated software techniques for blood-chemistry analysis with the Kodak Ektachem 400 analyzer. And exploration of potential product improvements in the Kodak Komstar 300 microimage processor, a computer peripheral which uses pulsed laser beams to convert digital data to alphanumeric images on microfilm at speeds up to 20 times faster than many ink-jet paper printers.

If you want to expand your horizons to meet the Kodak challenge, see a Kodak recruiter on your campus. Or send your resume to:
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Eastman Kodak Company
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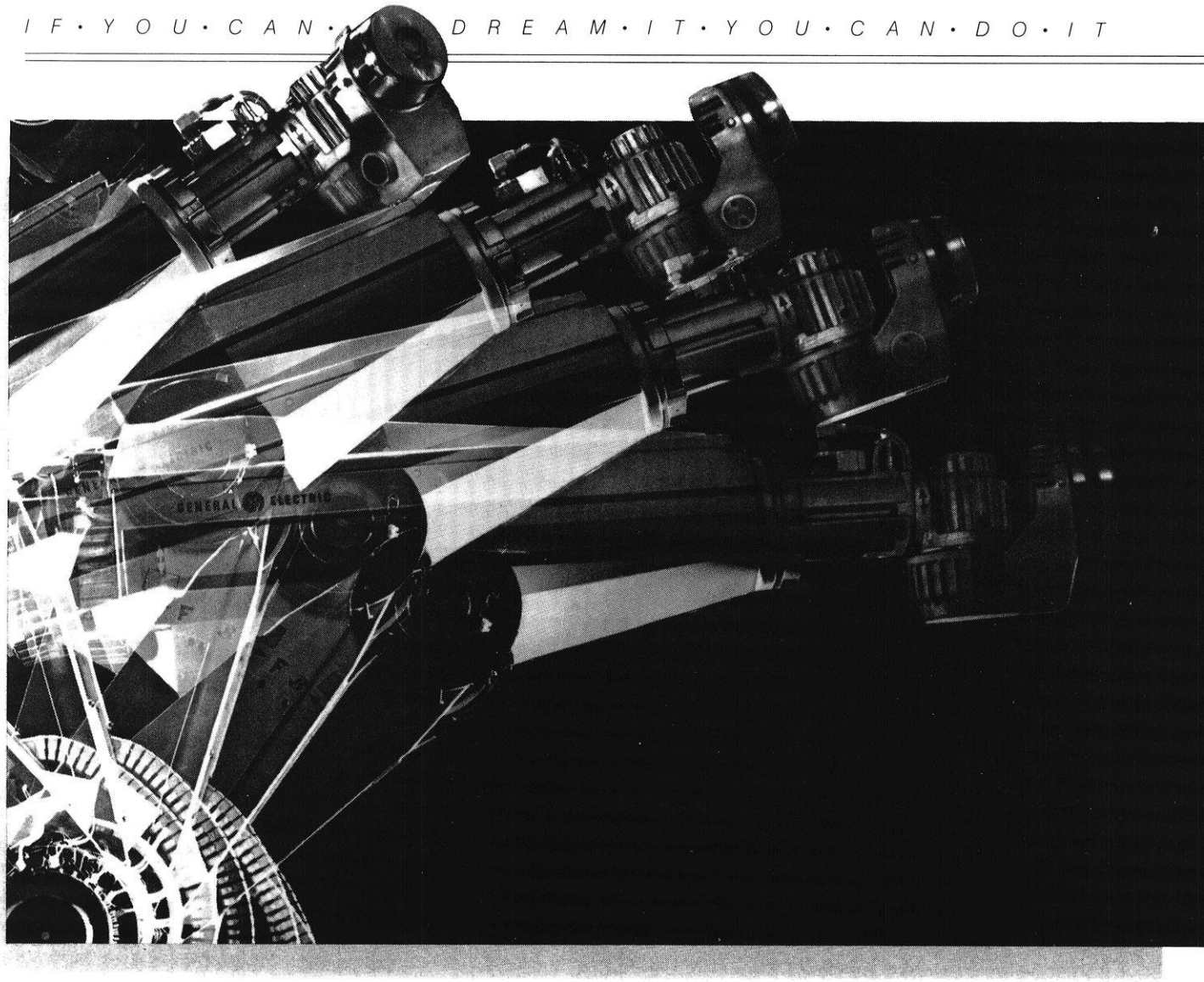


Teach a robot the facts of life.

There was a time when most robots earned their livelihoods in comic books and science fiction films.

Today, they're spraying, welding, painting, and processing parts at manufacturing plants around the world.

Necessity has caused this amazing leap from fantasy to factory.

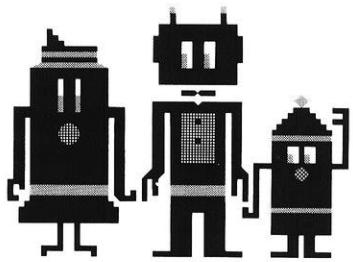
The world wants long-lasting, high quality products, now. And robots fit perfectly into this scheme of things: They can make those products – quickly, easily and accurately.

What kinds of robots? There is GE's Allegro,™ for one. It can position a part to within 1/1000th of an inch – or about ¼ the thickness of the paper this article is printed on. Or there's GP 132 (shown here). This loader, unloader, packer, stacker and welder – can lift and maneuver 132 pounds with no trouble at all.

So what's left for me to teach robots? You might ask. Consider this glimpse into the future by Dr. Roland W. Schmitt, head of GE corporate research and development:

"One of the big frontiers ahead of us is putting the robot's nervous system together with some senses – like vision, or touch, or the ability to sense heat or cold. That can give you an adaptive robot, one that can sense how well it's doing its job and make the adjustments needed to do that job better."

That's a tall order. And one we'll be expecting you to fill. With foresight, talent, imagination – all the things that robots have yet to learn.



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