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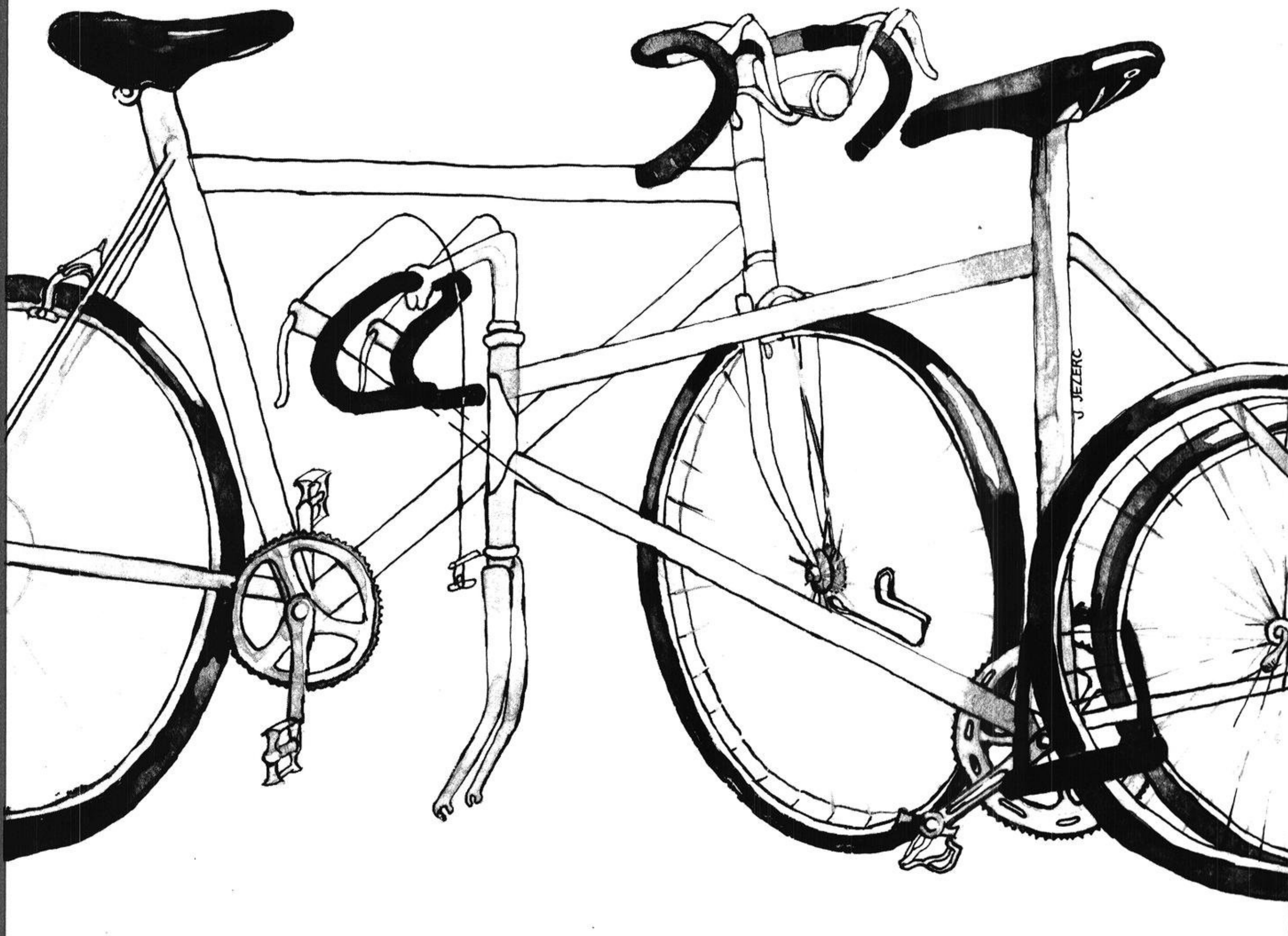
wisconsin engineer

Optimizing Bicycle Design:

An engineering problem



Also in this issue:

- Utility Diversification: Efforts toward Stability
- Alumni Honored for Life Accomplishments
- Inside the Nuclear Reactor

wisconsin engineer

PUBLISHED BY THE ENGINEERING STUDENTS OF THE UNIVERSITY OF WISCONSIN-MADISON. DECEMBER 1983

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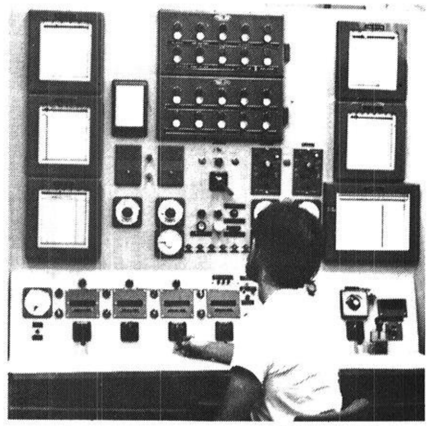

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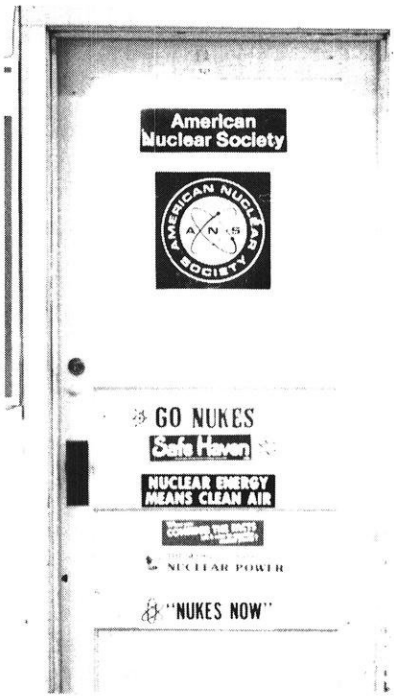

page 6 photo by Kurt Worrell

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Editorial

Climbing the Tree of Progress

By Scott Paul

A lot of the things people do don't seem to make a lot of sense. And when you look back through history you find the trademark of civilized man is that he tends to respond rashly in situations which should require a lot of careful consideration before taking action. He has a tendency to do things just because he is capable of them--not because he has a good reason to do so.

The Redwood and Sequoia trees of California are renowned for their size. They stand as impressive monuments to the power of nature to nurture life. These massive trees inspire awe and respect in the hearts of people who stand quietly next to these ancient symbols of life and power. When, then, did men find it necessary to build his roads so that they pass right through these living towers? Yes! We have roads that go through tunnels that were bored through trees which were hundreds of years old before Columbus arrived. I've never heard of anything so ridiculous. Why do we do it to them? Just because they are there.

Many of the purposes for which electricity is used seem equally absurd. In big cities we find electricity used for obnoxious advertising, to raise high-speed elevators to ridiculous heights, and to air-condition buildings. We use huge amounts of electricity to cool rooms when the same end could be achieved by designing buildings more carefully, or by opening windows.

Modern society seems to be having a love affair with electricity. We even tend to measure the progress of our society by the amount of electricity we produce. Why do we use so much power? Because we can.

Pre-industrial societies interacted with nature in a creative manner. They drained swamps, cleared river banks, built roads and cities--always using nature, but leaving something new and useful in place of what was taken away.

Our modern industrial society, on the other hand, is based on an extractive economy. We use up natural resources as fast as we can locate them. We do this because we pursue growth for its own sake; progress. Since 1940, the production of electrical power has doubled every ten years. This can't go on forever.

It is likely that the mismanagement and poor planning of today's society will make it impossible for future societies to enjoy all the technological marvels that we foresee for them. We will find that future societies will be forced by our negligence and carlessness to shape their behavior and thinking around cor-

recting damage to the environment, rather than focusing on growth.

This should not happen, and it doesn't necessarily have to. We are not slaves to growth. And we can define progress any way we darn well please. I'm asking you to look at your own definition of progress and see if it fits your idea of what we should be working for. If it doesn't, then change your definition of progress. Changes aren't progress unless they are the changes you want.

Word From Our Readers

Dear Mr. Paul:

Regarding your October '83 article, "Rainy Days and Nuclear War," it is this kind of defeatist attitude that keeps the people of the world from making a difference. As citizens of this country and this planet, we have the right and the responsibility to do what we can to improve our situation. This responsibility is not selfish pre-occupation with our immediate environment, where results can be seen and felt right away, but commitment to changing the way our friends, lawmakers and everyone else perceive the dire straights we are in. It's time to stop being "poor sick college boys" and become strong people who make strong changes.

Sincerely,
Steve Ruth, ECE

Dear Mr. Ruth:

By the same logic I might say that it is a selfish preoccupation to want to go traipsing off on some idealistic crusade to save the world when you could be right here helping old ladies cross the street. I could spend my time trying tot get politicians to agree with my views on nuclear warfare. But I think the effort would be better spent doing things that I know will accomplish some good. Ask a bum on State St. what worries him more, social injustices in foreign lands, the impending threat of nuclear destruction, or getting a hot meal in his belly? Tilting at windmills is a nice hobby if you've got lots of time and don't mind losing. I tend to think that working in the here and now is more productive.

Sincerely,
Scott Paul

Dear Editor:

Many prospective engineering students are intimidated by the high grade point requirements for admission in engineering departments. Their natural concern lies not with learning so much as achieving the grade point. Many students take courses for which they are over-qualified simply to get a high mark. Some drop down to lower level courses that they have already taken in high school. Still others may take courses that are labelled as "blow-offs" to achieve a high grade. The question to be asked is, would these people take such classes if there were no grade point average requirements?

The students with the highest grade point averages may not be the most qualified. The college should look at all relevant information with emphasis placed on learning, not on attaining a high grade point average. Without this emphasis, learning becomes a secondary objective of many engineering students.

An alternative to grade average requirements is to allow direct admission to the various degree granting programs. Every other Big Ten University admits students directly into degree granting programs such as engineering or business. These universities have not suffered any decline in quality in terms of student body or educational ability.

Admitting students directly from high school lessens some of the aforementioned perils of grade point requirements. It allows a student to seriously consider a major within the college of acceptance. Grade point requirements, however, make future planning much more difficult because the student does not know whether or not he will be admitted.

In essence, the University of Wisconsin is saying that a high school background is inadequate. Many argue that qualities of high schools vary. On the other hand, there are just as many variations in courses here as in the high schools.

If the college of engineering wanted to admit the best qualified students, then it would require them to take the same courses before being admitted. Alternatively, the college would require an admission test. Perhaps the College of Engineering should reexamine its admission policy and attempt to look for a more equitable policy.

Sincerely,
Kris Gupta

Dear Mr. Gupta:

Your main concern is well-founded. The engineering college does require excessively high grade points of the students it admits into engineering programs. However, the alternatives you suggest are even more unfair and impractical.

The fact remains that many more students are interested in engineering than can be accepted into the programs. Given these size limitations, a direct admission policy would mean that some students are denied admission to the engineering programs based on their high school record. The present policy at least gives every student a chance to prove himself in the same environment, with the same objective in mind.

Let me remind you that the basic pre-engineering courses such as calculus, physics, comp sci and chemistry are pre-requisites for admission, and they leave very little time in the schedule to "pad" the grade point. Your success in this first year of schooling is a far better indicator of your potential as an engineer than a single admission test.

It's unfortunate that the engineering school admission policies are this tough, but they are not unfair. A serious student who is capable of making it as an engineer will find a way to make it into the degree program.

Sincerely
Betsy Priem
Editor

Lake Water

By John Wengler

It's all there, right outside the interviewing rooms. Happy faces of content engineers, slick and shiny products, and Madison Avenue prose jump right out of company brochures, attracting students to work for the defense industry. But these brochures paint an incomplete portrait of defense employment; they only show the silver linings of a career usually clouded by job-secrecy, over-specialization, and transfer problems.

To broaden the job-hunting student's understanding of the defense industry, a group called the High Technology Professionals for Peace (HTPFP) has published a four-color pamphlet titled "Are You Considering a Job in the Defense Industry?"* The purpose of the pamphlet is to suggest questions for students to ask recruiters during interviews. If unsatisfied with the recruiter's answers, the student may avoid choosing the wrong career.

Company brochures do not discuss the job-secrecy inherent to the defense industry. Even before getting the job, an applicant is subject to a complete personal investigation. The person must provide a full account of employment and residence during the past 15 years. The applicant must also reveal whether she/he had ever been a member of any of "over 300 organizations appearing on a list compiled in the 1950's by the U.S. Attorney General."

Once on the job, the engineer is subject to restrictions unequalled in the civilian sector. Often a designer will be unaware of what a project will be used for, let alone be allowed to discuss the project at home, conventions, or in published papers. This causes isolation from the professional exchange needed to keep abreast with the latest technologies. But "perhaps most important," the brochure explains, "secrecy shields the individual from self-criticism. Participation, even if indirectly, in the development of weapons systems carries a unique responsibility."

Within the defense industry, engineers can become technically over-specialized. Weapons design is inherently different from other designs since weapons must operate "in the extreme conditions of a battle environment." Defense projects often enjoy open budgets and limited production runs, while most civilian products must be cost effective and designed for mass production.

The engineer's management skills can also become over-specialized in the defense industry. "Defense firms face limited competition, often operate on a cost-plus-fixed-fee basis, and have a government bureaucracy as a customer." Used to such conditions, a defense engineer would find the transition into the civilian economy a difficult one.

Politics also have an impact upon a defense engineer's career. Defense contract volume oscillates with the mood of the nation. The Reagan Administration is a boon for defense contractors, but a non-militaristic president in the future could bust many firms. In fact, the brochure reports that following the opposition to Vietnam in the early 1970's, "approximately 10,000 engineers and scientists were laid off in Massachusetts alone!"

Of course, once laid off, the problems outlined above compound. If the industry is in a slump for political reasons, all laid-off workers would have difficulty finding re-employment with another defense firm. If the worker is let go because she/he is too over-specialized or complains of excessive secrecy, other defense firms will probably avoid hiring that person. Civilian companies will also be wary of hiring a former defense engineer. (The HTPFP runs an employment agency that is dedicated to relocating defense engineers in the civilian sector.) But even with HTPFP assistance, the engineers still have difficulty finding jobs.

The HTPFP brochure concludes with a list of questions meant for recruiters. Some examples include: Specifically what project will I be working on? Can you provide me with figures on employee turnover? These questions and the answers they generate will fill in the gaps left by the recruiters' sales pitch and company brochure. Then, fully educated, the student can choose (or avoid) a career path which may be too difficult to alter in the future. □

*Copies of the pamphlet can be inspected at the Wisconsin Engineer Magazine office or can be obtained (for a $1 fee) from: HTPFP, 639 Mass Ave., Room 316, Cambridge, MA 02139.

Campus Research: From Superbike to Breathing Underwater

By Russ Wasserman

According to the 1982-83 Engineering Annual Report, over 17 million dollars will be spent on research projects throughout the UW Engineering Department. The Engineering Experiment Station will receive the most money, followed closely by the Nuclear Engineering Department.

The '82-83 expenditure is one half million dollars more than last year's, and nearly three million more than the '80-81 expenditure. This annual increase has been the trend for past years and should also continue for '83-84 according to Dean Coberly, Executive Director of the Engineering Experiment Station.

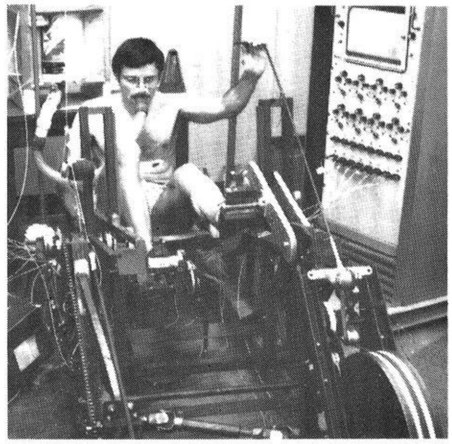
The topics of research span every facet of engineering, from "Elastic Satellite and Space Station Dynamics" (Engineering Mechanics) to "Thermal Regulation of Scuba Diving" (Mechanical Engineering). Some projects last for only one academic semester while others continue on for several years.

The federal government sponsors many of the projects, such as "Computer Simulation of the Effect of Wisconsin Mining Tax on Mine Profitability," a current Metallurgical and Mineral Engineering Department research project. Sponsored by the U.S. Department of Health and Welfare, the researchers use computers to simulate the effects of two controversial tax laws that concern ore deposits in Northern Wisconsin. Professor Rodolfe de la Cruz and Professor Robert W. Heins hope that computer simulation of laws, federal tax codes, and inflation rates will lead to a better understanding of the effects of these measures on mine profitability.

A current research project in the field of biomedical engineering is "Wheelchair Activity Monitor for Patients with Spinal Cord Injuries" under the direction of Professor Willis J. Tumpkins and Professor Robert M. Jones. One of the most serious complications with this type of injury is tissue breakdown caused by sitting for long periods without pressure relief. Complications resulting from tissue breakdown can result in hospitalization. In order to prevent pressure-induced breakdown, the patients must relieve pressure on a regular basis by shifting their weight, or if the use of arms is not impaired, pushing their bodies up.

This project aims to develop a microprocessor-based device that monitors body shifts in the wheelchair and stores this information. The device has an alarm to remind the patient and fits completely under the wheelchair. This monitor will provide the therapist with quick information as to how the patient is progressing with learning how to relieve pressure. This device would become extremely important when a patient is first learning to tolerate sitting after prolonged bedrest.

Another project, "Life Support Equipment for Shallow and Deep Underwater Breathing," under the direction of Professor Ali A. Seireg, concentrates primarily on developing naval breathing systems and improving the performance of existing equipment. Some of the devices which have considerable potential for



Craig Cornelius goes for a workout in Prof. Seirig's motion cycle simulator that measures the efficiency of over 2000 pedaling trajectories.

development are: snorkels capable of providing a continuous supply of fresh air without surfacing, high efficiency air regulators capable of operating at different temperature conditions with rebreathing options, light weight diving tanks, and lighter control systems for chemical breathing equipment. This project is in the Mechanical Engineering Department and is sponsored by the Sea Grant program.

Prof. Seirig is also studying the "Design of Mechanisms for Optimal Bicycling." This project investigates the human-machine interaction in bicycling and develops procedures for the optimum design of pedal mechanisms to minimize the human effort in long duration bicycling.

These projects are just a few of over 700 projects under study this year. For a complete summary of all research projects and statistics concerning expenditures, see the College of Engineering Annual Report 1982-83, available from the Dean's office. □

Engineering Research Expenditures 1982-83

Each unit represents $1000

Department	University Budget	Research Grants	Federal Govt.	Business & Foundations	Graduate School Research	TOTAL
Chemical	60	0	1023	627	214	1925
Civil & Environmental	117	95	561	94	87	952
Electrical & Computer	89	0	1994	433	237	2753
Engineering Mechanics	22	0	161	28	32	243
Industrial	62	0	838	320	74	1294
Mechanical	131	0	713	547	108	1500
Metallurgical & Mineral	22	4	1160	130	171	1487
Nuclear	182	0	2941	302	16	3441
Eng. Experiment Station	1629	4	657	1362	44	3696
TOTALS	2316	102	10048	3843	982	17291

Taking a Look Inside the Reactor

By Scott Paul

When someone mentions nuclear power at a dinner party he is likely to get quite a few different reactions from people. Generally these reactions range from vague superstition to outright fear. Most people, however, whether for or against nuclear power, will readily admit that they don't really understand exactly how a nuclear power plant works.

The isotope Uranium-235 is the main fuel for a power reactor. When an atom of U-235 is struck by a neutron traveling at a relatively slow speed the U-235 will absorb the neutron and become unstable. The unstable U-235 atom will split into two smaller particles and it will also release some neutrons which are capable of starting more reactions. The sum of the weights of the fission product is a tiny bit less than the weight of the original U-235 atom and neutron. That tiny bit of matter was converted into energy; but Einstein's equation $E=mc^2$ states that just a speck of matter can be converted into gobs and gobs of energy.

Some of the energy produced in the reaction appears in the form of gamma rays. Gamma rays are like the microwaves used to cook food, except that they have more energy. These are not very useful in a reactor; all that happens is that they end up getting absorbed in the thick shield surrounding it. Most of the energy shows up in the form of kinetic energy. The fission products are moving very rapidly after the reaction. These fission products lose their kinetic energy by colliding with the surrounding substances and raising their temperature. This thermal energy is what we use to extract power from the reactor.

In a Pressurized Water Reactor, the water is kept around the reactor core at high pressure. The water runs through a heat exchanger where it heats up other water which is at a lower pressure and creates steam which is run through a turbine/generator system. Note that the water that is in direct contact with radioactive materials never leaves the system.

In a Boiling Water Reactor the water around the core is kept at a lower pressure so that steam is generated within the reactor vessel itself. Again, no water that has been in contact with radioactive materials leaves the reactor.

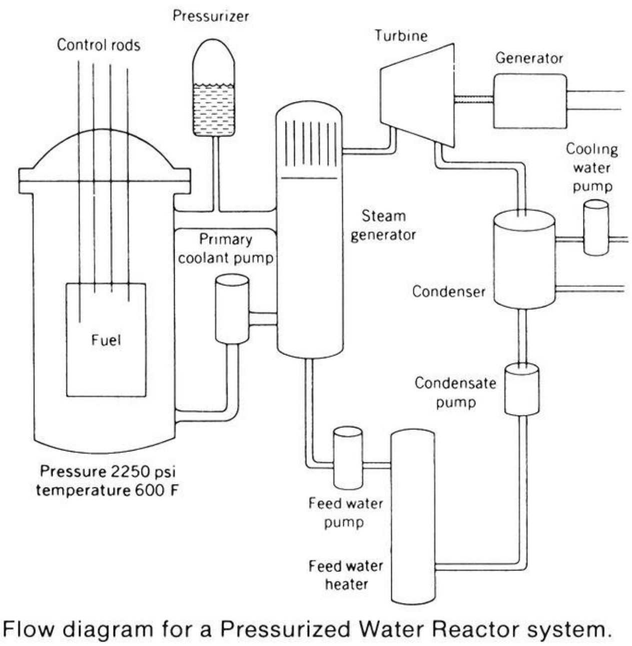
"Just a speck of matter can be converted into gobs and gobs of energy."

In addition to serving as a coolant and a means of heat transfer, water also acts as a moderator. The neutrons which are produced in the fission reaction are traveling at high speeds, but neutrons that travel slower are needed to hit uranium atoms and keep the chain reaction going. Fast neutrons will give off a lot of their energy to water atoms by colliding with them. The neutrons are said to be moderated when they are made to travel at speeds which are comparable to those of the atoms surrounding them.

Natural uranium contains only 0.7 percent U-235. For a reactor to work efficiently it needs to use fuel that contains at least 2.5 percent U-235. The process of enrichment begins by reacting uranium with flourine to get UF_6, which is a gas. The molecules which have U-235 weigh a bit less than the ones with U-238 so at any given temperature they move a little faster. If a mixture of these two gasses is placed on one side of a thin membrane the molecules with U-235 would pass through it faster so its concentration on the other side would be slightly greater. This process is repeated until the desired degree of enrichment is obtained. The UF_6 is then converted into UO_2, a solid out of which fuel pellets for the reactors are fabricated.

The fuel pellets are small, about 1.5 cm. long, but about 240 of them go into each fuel pin, and the reactor core contains about 36,000 of these pins.

A common fear among people is that a nuclear reactor might blow up on them like a big bomb. This can never happen. Uranium needs to be enriched to about 90 percent U-235 to be useful in explosives, and it needs to be packed into a small volume. In a reactor the fuel is of too low enrichment and too spread out to act as an explosive.



Flow diagram for a Pressurized Water Reactor system.

The most serious potential accident that can happen is one where coolant around the core is lost and some radioactivity is released. A lot of highly unlikely things would have to happen in order for this to happen.

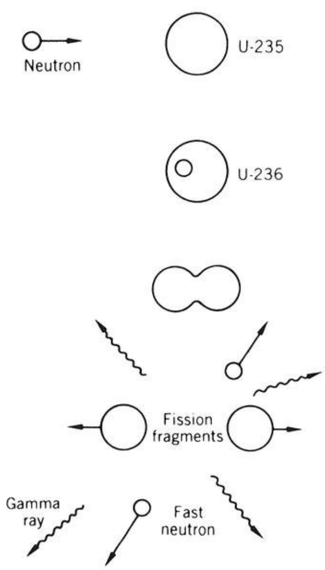


Diagram of the nuclear fission process.

When any unusual behavior such as a power surge is detected, boron control rods are automatically dropped into the core. These rods absorb the neutrons that are needed to keep the reaction going. The reactor is effectively shut off. The problem is that the fission products from the uranium reaction are radioactive themselves and continue to generate heat after the reactor is turned off. If the reactor is not kept cool enough it is possible that the metal surrounding the fuel pellets might melt. That is why there are several backup systems which will pump water in to keep things cool. Yet even if things do get out of hand the reactor building itself can be sealed off. The only reason radioactivity might leave the building is if the operators find it necessary to release gas pressure within the building.

Breaking Ground in High Protein Food

By Darci Buelow

In the middle of the semester, most college students are wondering whether or not they will make it through the rest of their program, let alone the profession they choose after grduation. But what about the life that follows graduation, a career, and finally retirement? What potential is there for continuing research in one's later years?

Professor Hjalmar D. Bruhn of the Agricultural Engineering Dept. retired in 1978, looked at his options and headed for research. His current project is as inspirational as any progressive college student could want.

In Wisconsin, 3 million acres of land is devoted to the production of alfalfa which is harvested up to 3 times a season. Storage of this plant as feed for livestock is an engineering problem in itself. It must be stored with precisely the right ratio of moisture to dry matter. If this ratio is too low, spontaneous combustion could result and if it's too high, the feed degrades and is unsuitable for livestock.

Bruhn was instrumental in developing a mechanical process to dry the alfalfa so as to obtain the correct moisture ratio for storage. The process, known as "alfalfa juice protein concentrate production," starts by chopping the plant material and macerating or squeezing the tissue to separate the juice from the fiber. This leaves a silage which is 144 lb. of dry matter with 26.8 lbs. of water per 1000 lbs. of alfalfa.

The juice that is squeezed from the alfalfa contains 48 lbs. of dry matter and 518 lbs. of water per 1000 lbs. of alfalfa. Bruhn realized that this juice was high in protein and other valuable nutrients, yet was being discarded by farmers who were separating for a silage ratio.

In Wisconsin, this high protein concentrate is occasionally fed to livestock mixed with other feed, but human consumption is limited because of the unappetizing appearance of the paste. (It wouldn't even pass as dorm food.) Yet in underdeveloped countries, this paste could make a dramatic difference in the low-protein diets of the low income people.

Bruhn has spent the last few years of his retirement working with an English organization called "Find Your Feet," which seeks to teach underdeveloped nations to help themselves rather than just supplying them with food. Bruhn designed a plant juice protein concentrate production system that can be used at home. Various plants other than alfalfa, such as Berseme clover, can also be used in the system.

"Find Your Feet" set up a test case for the system in the Baja Pennisula, Mexico. Fifty-eight children were selected to make and eat the concentrate 5 days a week. Of these children, 56% were underheight and/or underweight. The meal consisted of a tortilla spread with a red bean paste and topped with the protein concentrate paste.

"Bruhn designed a plant juice protein concentrate production system that can be used at home."

After 4 months of treatment, 50% of the boys and 18% of the girls had reached normal height and weight. These results have inspired Bruhn to pursue designing a system which can be used without requiring electrical power.

Bruhn has traveled to Mexico to visit the children and is able to truly appreciate the significance of the research and the direct benefits of his hard work. One might learn from Professor Bruhn's fine example that you are never too old to make valuable contributions to society if you are willing to work for something you think is worthwhile. □

The Illuminated Vortex

Understanding how the in-cylinder flow of the fuel-air mixture is influenced by chamber geometry provides a key to improving engine performance. By applying a laser measurement technique, a researcher at the General Motors Research Laboratories has gained new insight into the behavior of the flow.

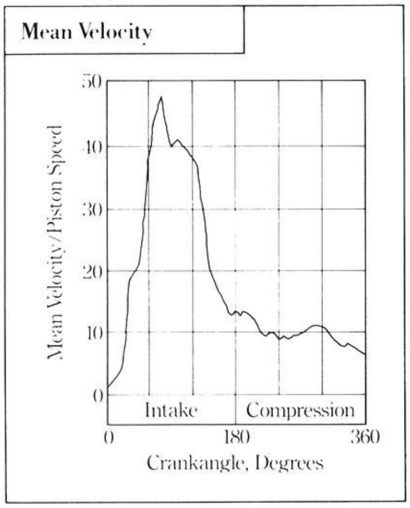
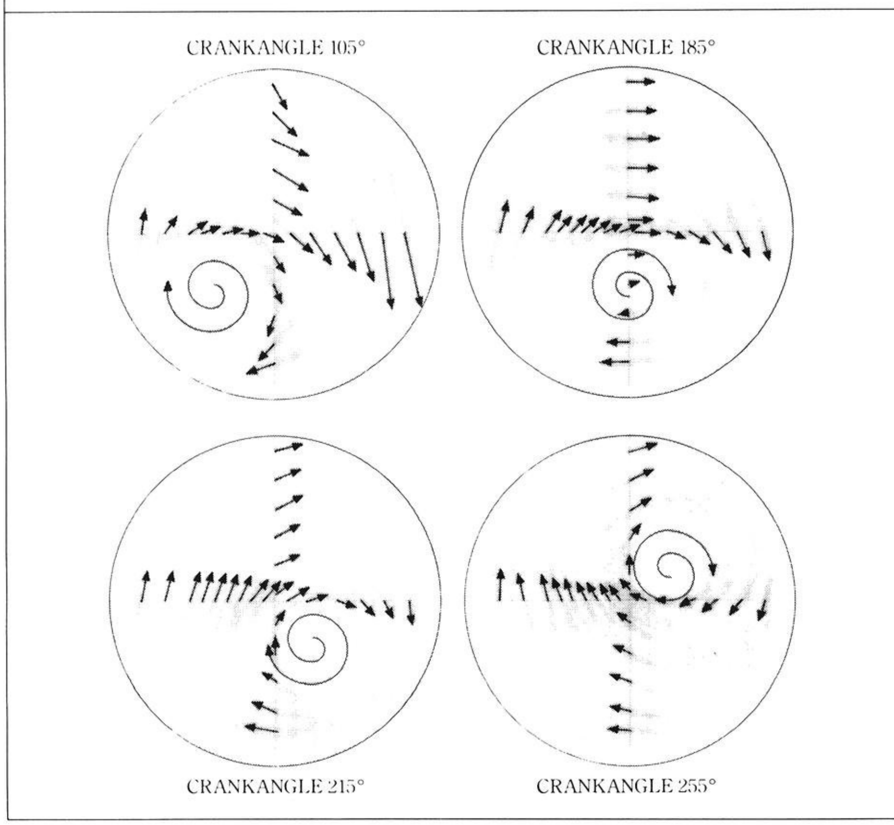


Figure 1: History of mean velocity at a single engine location.

Figure 2: Panoramic view of engine flow patterns. With changing crankangle, the center of rotation precesses from the cylinder's lower left quadrant to its upper right quadrant.



THE FLUID motions inside engine cylinders have considerable influence over the progress of combustion. Mixing of air and fuel, combustion rate, and heat losses from the cylinder are all important transport processes strongly dependent on fluid motions. The motion inside the cylinder has two components. Mean velocity influences the transport of momentum, energy, and species on a cylinder-wide scale, while the turbulence component influences the same phenomena on a local basis. The in-cylinder flow field depends primarily on the geometry of the cylinder and inlet port. Hence, decisions made in the engine design stage exert a controlling influence over the flow. But before questions about how different geometrical features affect the flow field can be answered, the problem of how to measure the flow must be solved. By applying Laser Doppler Anemometry (LDA), Dr. Rodney Rask, a researcher at the General Motors Research Laboratories, has obtained detailed measurements of the flow field.

LDA is a technique in which two focused laser beams pass into the cylinder through a quartz window. In the minute measuring region where the laser beams cross, a regular pattern of interference fringes is created. As the 1-micron particles, which have been added to the engine inlet flow, cross the measurement region, they scatter light in the bright fringes. In Dr. Rask's LDA system, the scattered light is collected by the same lenses used to focus the laser beam, and measured by a photomultiplier tube. The resulting signal is processed electronically to determine the time it takes a particle to traverse a fixed number of fringes. Since the fringe spacing is a known function of the laser beam crossing angle, this transit time provides a direct measure of velocity.

During operation of the LDA, measurements of velocity as a function of engine rotation (crankangle) are made at a number of locations within the cylinder. The instantaneous velocity at each point must then be separated into mean and turbulence components. The simplest technique is to declare that the mean velocities for all cycles are identical and ensemble average the data. However, this approach ignores the cyclic variation in the mean velocity. Another technique looks at individual cycles and uses a variety of methods, including sophisticated filtering, to split the instantaneous velocity into its components. This approach is consistent with the LDA measurements, which clearly show that the mean velocity does not repeat exactly from one engine cycle to the next.

Differences in the flow field from one cycle to the next can seriously compromise engine efficiency. Near the end of the compression stroke, it is important to maintain a consistent velocity at key cylinder locations (e.g., at a spark plug). Dr. Rask's LDA measurements have identified design features that control cyclic variability.

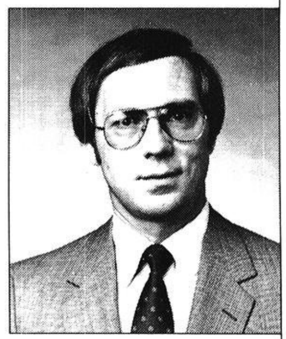
FIGURE 1 shows mean velocity measured at a single location during an engine cycle. High velocity exists during the intake stroke when the inlet flow is rushing through the narrow valve opening. This jet-like flow into the cylinder causes large velocity differences between adjacent cylinder locations and produces strong turbulence. As the end of the intake stroke is approached (180 degrees in Figure 1), the levels of both mean velocity and turbulence drop rapidly. This decrease is a result of the changing boundary conditions for the cylinder—from strong inflow to no inflow. During the compression stroke the flow field evolves, but it undergoes no drastic changes. However, in a high-squish chamber, where the flow is forced into a small bowl in the piston or cylinder head, considerable turbulence is generated near the end of the compression stroke.

Measurements from many cylinder locations are necessary to make the flow field understandable. Figure 2 shows four flow patterns covering a period from near the end of intake into the compression stroke. Note the strong vortical flow, with the center of the vortex away from the cylinder center and precessing with changing crankangle.

By experimenting with geometrical variables, Dr. Rask has gained new understanding of phenomena observed in operating engines. The resulting knowledge has guided the design and development of new engines with a minimum of trial-and-error testing. The LDA findings are also being used to validate and calibrate engine flow computer models under development.

"From our measurements," Dr. Rask states, "we have been able to deduce how changes in the geometry of the port and combustion chamber modify the velocity field. These flow field effects are now being used to help designers tailor engine combustion for optimum performance."

THE MAN BEHIND THE WORK



Dr. Rodney Rask is a Senior Staff Research Engineer in the Fluid Mechanics Department at the General Motors Research Laboratories.

Dr. Rask received his undergraduate and graduate degrees in mechanical engineering from the University of Minnesota. His Ph.D. thesis concerned the Coanda effect.

Prior to joining General Motors in 1973, Dr. Rask worked on the design of nuclear reactors at the Knoll's Atomic Power Laboratories. In addition to further refinements in LDA measurement techniques, his current research interests include computer simulation of engine systems, with special emphasis on the intake manifold.

Alumni Honored for Life Accomplishments

By Mary Beth Anderson

Eight Wisconsin alumni were recently honored with distinguished service citations at the University of Wisconsin's College of Engineering annual Engineers' Day dinner.

Two awards for faculty excellence were presented at the dinner. W. Robert Marshall, former Dean of the College of Engineering and current Director of the University Industry Research Program at UW-Madison, was presented with the Byron Bird award for excellence in a research publications.

Professor Charles G. Hill, Jr. was presented with the Benjamin Smith Reynolds Award for excellence in teaching. Hill, who teaches thermodynamincs, kinetics, catalysis, and reactor design, has previously won six awards for teaching students.

Earl J. Beck, executive vice president of Harza Engineering Co., Chicago, was cited for leadership in the design and construction of some of history's largest civil engineering works, including hydroelectric, irrigation and flood control projects.

Russell J. Christesen, president and chief operating officer of Ebasco Services Inc., New York, was honored for contributions to the negotiation and foundation of a national Nuclear Power Construction Stabilization Agreement to be implemented on nuclear construction sites.

John E. Gwyn, research engineer and senior research associate with Shell Oil's Shell Development Co., Houston, was cited for his contributions to reactor mechanics and fluid dynamics research in oil, chemical, and coal and shale processing.

Donald A. Gyorog, associate technical director for Systems Concept and Technology, U.S. Army Armament Research and Development Command, Dover, New Jersey, was cited for his contributions to U.S. Army Armaments research in large and small caliber weapons, ballistics, and computer aided design systems.

John H. Johnson, presidential professor of mechanical engineering and engineering mechanics at Michigan Tech. University, was honored for contributions through research to the development of procedures that monitor harmful engine pollutants and measure wear in diesel engines.

Glenn A. Petersen, president and chief operating officer of Simplex Time Recorder Co., was cited for contributions to the design, development and production of communication and building security sytems.

William R. Schowalter, professor of chemical engineering at Princeton University, was honored as a researcher and educator in fluid mechanics, especially as it transcends specific engineering fields.

Claude R. Whitney, chairman and chief executive officer of Allen-Bradley Co., Milwaukee, was cited for contributions to the technology of precise industrial controls, to the control of American and Wisconsin Industry, and to the greater Milwaukee community. □

Putting Eggs in Many Baskets: One Route to Economic Stability

By Scott Knox

From the industrial revolution to the 1960's there was an average increase of seven percent per year in the demand for electricity, and a similar growth rate for natural gas. During this time utility companies grew in a healthy economic environment and benefitted from economies of scale. Then came the seventies, a decade of skyrocketing energy costs, social awareness of energy consumption, and conservation. The result was an abrupt slowing of the growth rate. The utility companies found themselves overestimating in their predictions, and thus slowing down their planning and construction in adjustment to the changes in society.

Today in the eighties consider Joe's Utility Company. Joe has a one percent annual increase in demand for electricity and a decreasing demand for natural gas. His cost per new kilowatt produced is greater than what he makes from that kilowatt, and he is no longer building a new facility every year. In fact he doesn't plan to start another one until after the year 1990. What is Joe to do?

This energy situation has caused utility companies to study their economic position. One viable solution utilities are actively exploring is growth through diversification.

Paul Koeppe, a planner for WP&L, sees several changes occurring during the diversification of WP&L.

Wisconsin Power and Light (WP&L) is a Madison based, central Wisconsin utility. Jerry Olson, a strategic planner for WP&L describes the company and the industry as "maturing", and says that "Wisconsin Power and Light is seeking better growth, and lower risk through business diversification". Some of the areas that WP&L is exploring and/or involved in are Telecommunications, Environmental Services, and Energy Services.

As the name implies, diversification involves several types of activity. In economic terms, diversification is a capital investment in a variety of businesses. Usually this implies having over half of the stock in various companies. Paul Koeppe, a planner/developer for WP&L, sees several changes occuring during the diversification of WP&L. First are the effects of owning subsidiaries; second is more involvement with the changing energy field. Wisconsin Power and Light's involvement on both of these fronts is being researched and actualized.

Telecommunications is one field which is developing rapidly. WP&L is watching this field closly for potential investment opportunity.

The environmental service which WP&L is studying is that of industrial waste management. Jerry Olson notes that WP&L is a holding company of a waste management subsidiary. Their involvement is beyond the research stage with their recent acquisition of Residuals Management Technology, Inc. of Madison. RMT specializes in solid and hazardous waste management.

Wisconsin Power and Light is also actively involved in the area of energy services. About two years ago a research portion of WP&L was doing a routine study of an energy product. The product performed so well during the tests that WP&L decided to invest in the company. The product is a wind energy conversion system. The company, Windworks, has been a subsidiary of WP&L for the past 18 months. Windworks has two main products: the wind turbine, called the Windworker and a synchronous inverter, called the Gemini, which is a device for changing the DC output of the turbine into AC that is matched in phase with the power lines. Windworks sells its products in the U.S. and abroad and is reported as doing well.

Wisconsin Power & Light strategic planner Jerry Olson says that WP&L is seeking better growth and lower risk through business diversification.

A question one might ask about a utility's diversifying efforts is: How will this affect the utility's services and customers? This is a complicated question. By investing in growing, potentially profitable businesses, a utility can increase its marginal revenue and strengthen its financial condition, provided the investments are good ones. Economic stability would result in a utility that could provide good utility service at a minimal cost. Opponents to utility diversification contend however that utility diversification might result in an overemphasis on corporate profits so that subsidiaries might divert the utility's attention away from their primary function.

It is apparent that because of stable energy demand and their present marginal costs, utility companies will have to increase their marginal revenues. Making diversified capital investments is one way that utilities can solve the economic problems they are now facing. It is one example of how American businesses must constantly be on the lookout for new ways of doing things in order to stay afloat in a troubled economic sea. □

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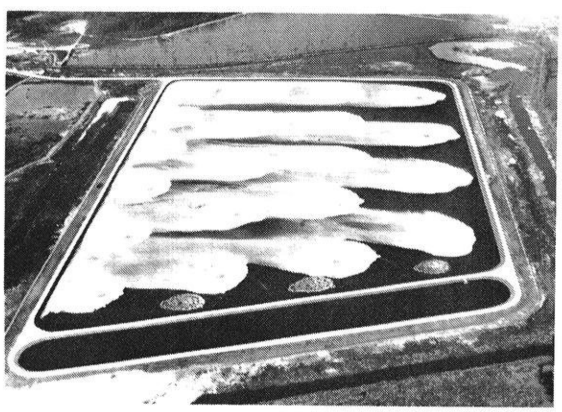

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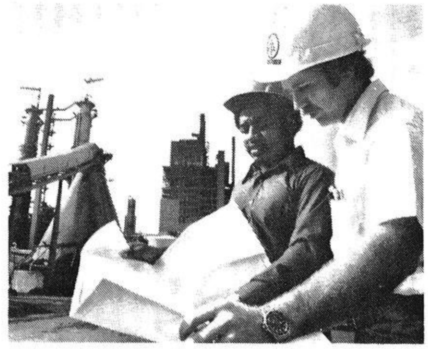

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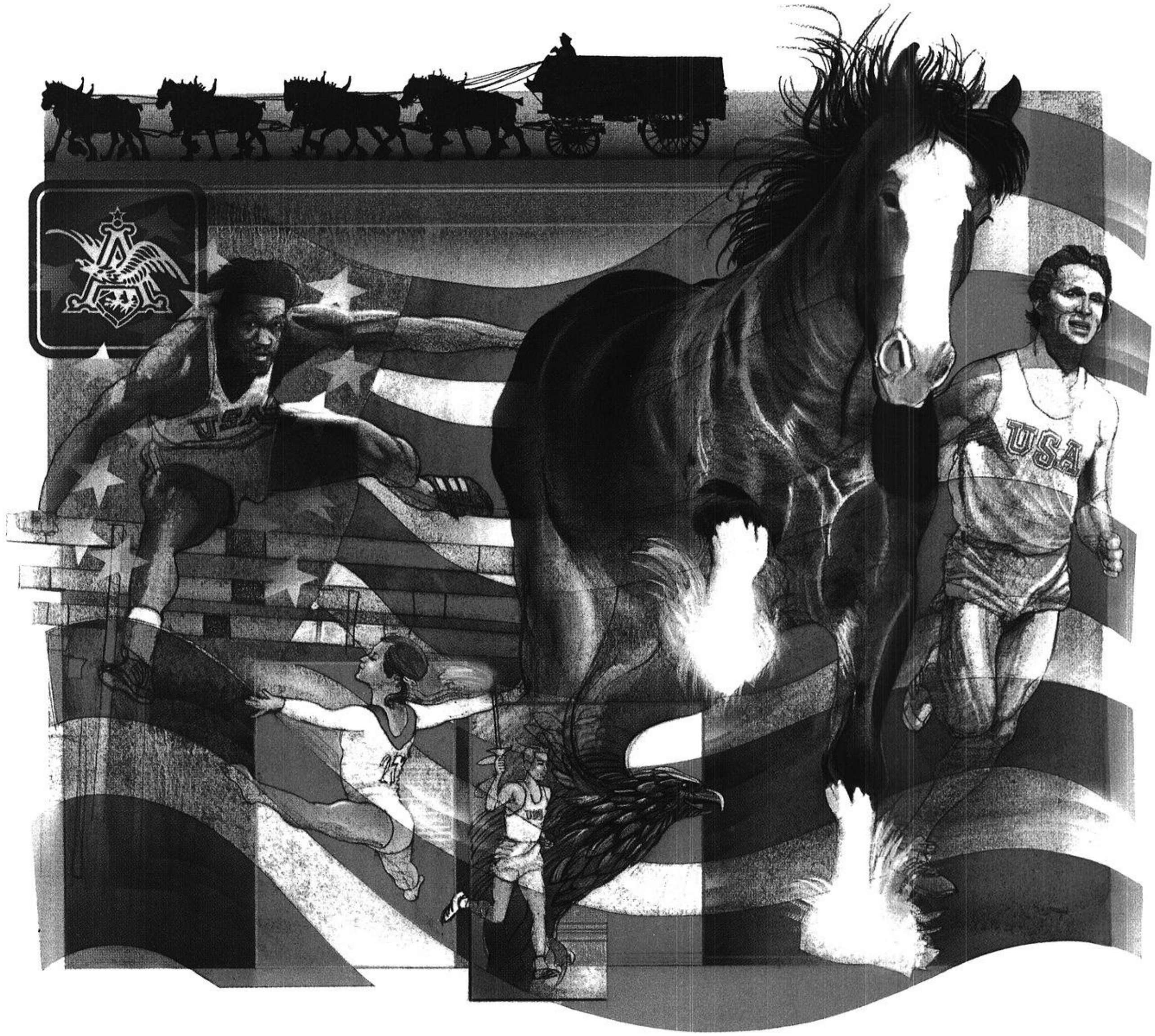

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A Taste of the Real Thing: The Co-op Program

By Deanna Tenor
and Dawne Stevens

Cooperative Education is an old alternative in engineering education that is taking on new importance because of the recent flood of engineers on the job market. Job openings aren't as plentiful and engineering students must look for ways to increase their postgraduate employability. A growing number of students are turning to the cooperative education program for that purpose.

Cooperative education is a tri-fold agreement between the student, employer, and school that provides many benefits for all three. Each student alternates semesters between work and school.

"It gives the feeling of being partially out of college early."

Perhaps the greatest benefit of coopping is that co-op students are more employable and receive higher starting salaries than students who are not in the program. It has been found that 90% of co-op students find immediate job placement at graduation, as compared to only 30% for students not involved in the program.

The school is not left out from the benefits either. This program eases enrollment pressure in crowded departments and it finds students coming back from work periods with a much more enthusiastic attitude toward classes. The higher percentage of graduate placement also gives the school a better national reputation.

We talked to a few co-op students and they were willing to share their experience with the program.

Carol Loveland: "Upon commencement from college, joining America's work force can be difficult at best, unless the engineer has an edge. One of these could be graduating with the highest honors, another is knowing someone on the inside. Maybe not the quickest, but by far the most worthwhile edge is in cooperative education.

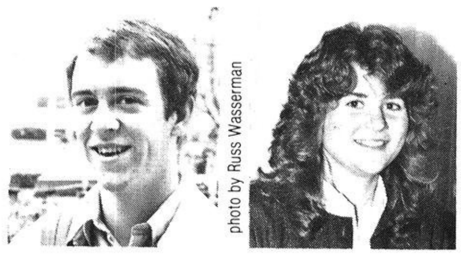


photo by Russ Wasserman

The experience gained, both social and work-related, is invaluable. The whole attitude about how problems are handled and how co-workers interact and react with each other and management, is quite different from college. It takes readjustment of one's line of thought. With this comes an added maturity and confidence.

Real life problems are not like textbook problems. The engineer is not given all the information and variables. He must learn how to research to find the problem and the necessary information. This is a hard skill to learn, but it is a necessity.

By co-opping, one can learn these skills and gain confidence during school years. This is also a great way to view different types of jobs and come to a decision about which is the most appealing. Many graduating seniors do not know what area of their chosen field they would like to enter, while a cooperative engineer often is moved from job to job, getting hands-on experience in many areas.

The company the engineer is employed with has the option of hiring the student after graduation. If the company is pleased with past performance, it is profitable to them because they have already trained the engineer. Most interviewing companies would rather take a student with two years experience and training over a senior with relatively little. In conclusion, co-operative education will see the graduate financially stable, a few years experience underfoot and confident on that first day of work."

Stan Frey: "The co-operative education program was first brought to my attention in a freshman orientation lecture. I decided as soon as I heard of the program to see if I could get involved in it. For me, the reasons in favor of co-opping far outweighed those against it.

The co-op program opened a lot of opportunities for me. The first was the chance to get interviewing experience and practice in writing a resume. Most co-ops don't get a job on the first interview, so they get a chance to hone their interviewing skills. This proves to be helpful when interviewing for permanent employment, also.

After getting a job I found I had hit a gold mine of opportunities that many engineering students at Wisconsin never consider. Simply working on a day-to-day basis with professional engineers, technicians and administrators gives the co-op the skill to solve practical industrial problems. These management skills can't be learned in the classroom.

The only disadvantage that many see with co-opping is the added time it takes to graduate. Many students have attitudes that they just want to get out of college as fast as possible. I have the same attitude, but I really don't see cooperative education as dragging out my college career. On the contrary, it gives me the feeling of being partially out of college early.

Every other semester I get a chance to live in the "real world" where my life doesn't revolve around getting three problem sets done by Monday. Although I like the college social life, I find myself looking forward to going back to work for a semester and living in a society where weekends are all mine and everyone isn't between the ages of 18 and 23.

This social variety and the fact that I earn more than enough to put myself through school far outweighs the fact that I graduate a year later. To put it simply, I feel like co-opping really gives one a head-start on life after college and I'm glad I got the opportunity to experience engineering in the "real world" while still in school. □

Engineering Recruitment Looks Up

American companies are looking for engineers again, according to recuitment figures at University of Wisconsin-Madison.

James A. Marks, head of the College of Engineering placement office, reported in November that 18 percent more companies have come to campus this fall than came last year at the same time. The number of firms that have canceled visits -- because they have no job openings -- is down 31 percent.

"We are absolutely full up," said Marks, pointing to his recruiting appointment book. "It's safe to say we're up at least 15 percent in recruiter activity on campus."

For Marks, that's a reason to begin smiling again.

The turnaround in engineering recruitment comes after a disastrous year that saw seniors waiting in line overnight for interviews with companies that had few if any openings. The lines are shorter now, an hour at most, Marks said, and he is convinced from experience that the increase in recruiter activity will turn into jobs.

"When recruiting started, I wasn't anywhere near as optimistic as I am now." He said he's looking forward to next spring when, he said, "I hear from others (recruiters) that things are really going to take off."

One company recruiter, John R. Youngblood of Cummins Engine Co., Columbus, Ind., said he's looking for engineers again because his company is convinced the recovery will persist at least into 1985. "Orders are starting to pick up" for the firm's diesel engines, he said, and he is looking for graduates in electronics, mechanical engineering and engineering mechanics.

In addition, said Youngblood, Cummins is seeking engineers that can provide the firm some flexibility in the future. "We're hiring people with more generalized skills now, rather than specialists," he said.

Marks contrasted this fall's upbeat feeling with a job market that was "devastated" last year. "Everybody's more optimistic about the market," he said.

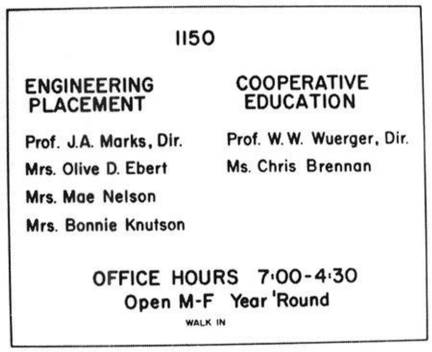


photo by Brad Carlson

Marks still remembers 1982-83 with a shudder. "I've never seen it as bad as it was last year, and I've been doing this for almost 30 years," he said.

"I was appalled one night last spring. I walked out of here at 5:30 p.m. and there were already students in line with sleeping bags (for morning interviews). I couldn't sleep. I came down at midnight and let them in."

It was a year, he said, when only top students got several job offers and when graduates in chemical engineering -- normally a hot field -- were stung by slowdowns in the chemical and petroleum industries.

This year, he said, "we're finding companies looking for chemical engineers." The number of companies on campus is up 18 percent. The number of recruiters is up 16 percent. Reports of job offers are beginning to come in. And most companies, it seems, are looking for electrical engineers.

"There's no question that electrical engineering is top priority, and top demand," he said. Other seniors having little difficulty in gathering job offers are women, minorities and those with a "B" average or better, he said.

About 40 percent of the college's 1,000 seniors graduate in December, Marks said. Another 50 percent graduate in May and the other 10 percent in August. About two-thirds of the graduates are hunting for jobs, he said, and almost all of those use the college's placement service. □

(cont. from page 7.)

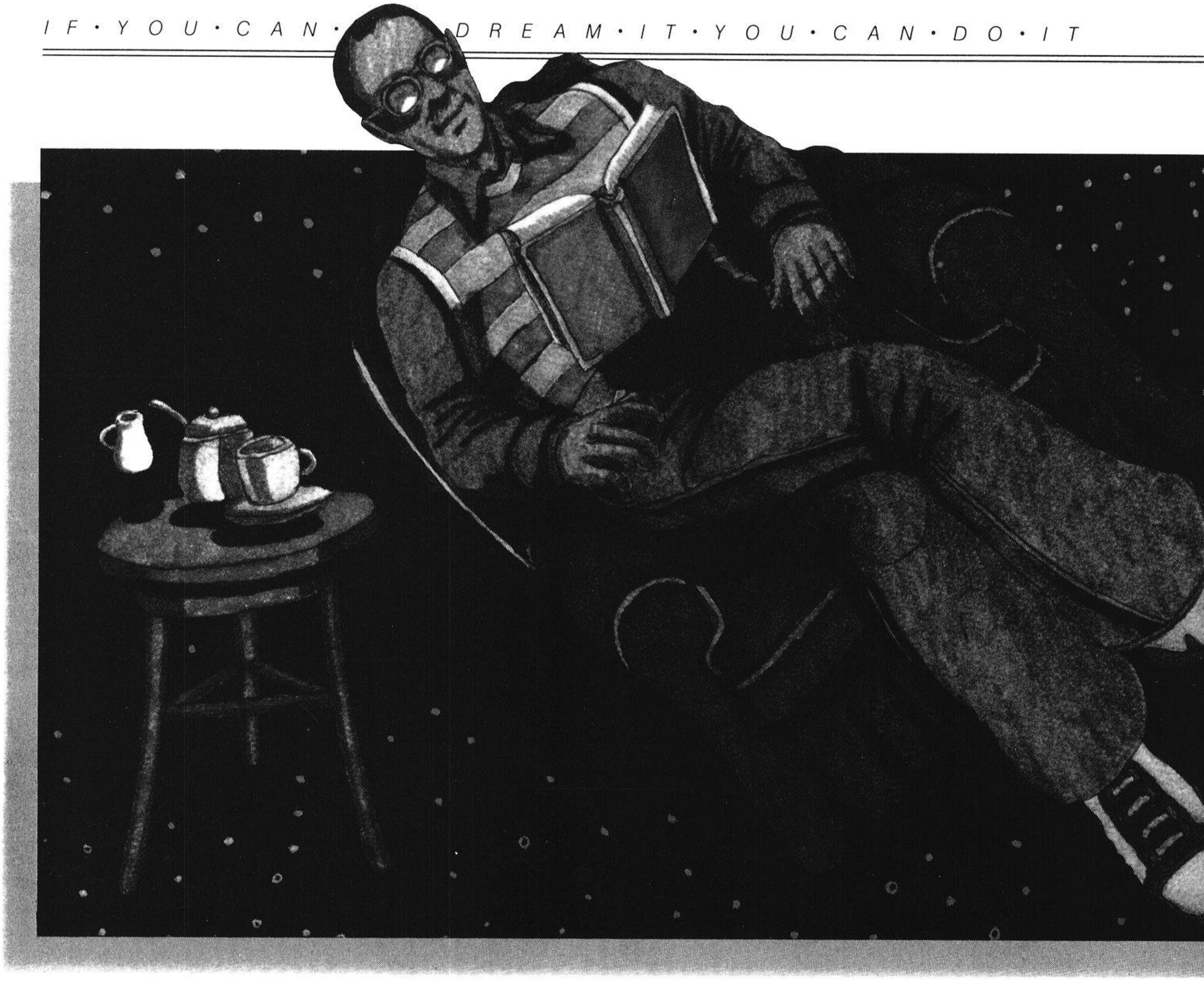
Nuclear power plants produce two forms of waste. One is excess heat that must be disposed of. One method involves using cooling ponds where hot water from the reactor is allowed to cool off before it is returned to the environment. A more expensive method is to run the water through giant cooling towers where air is used to cool off the water pipes. The water is generally put back into the reactor in this case.

"A nuclear reactor can never explode like a bomb would."

Radioactive waste in the form of spent fuel rods is another problem that needs to be dealt with. Because they remain radioactive and pose a health hazard that will last for thousands of years their disposal requires special attention. At the moment most of our spent fuel is simply stored in large pools, but this is at best a temporary measure. The accepted method for disposal is to bury it in geologically stable rock formations over a half mile under the ground. Unfortunately the first such repository is not expected to be operational until sometime in the 1990's.

Whether you consider it to be good, bad or ugly, nuclear power is used by our society. Although this article only hits some of the basic points, it brings out enough to give you a general idea of how a reactor works. We're going to have to make a lot of decisions as to what role nuclear power will play in our future. And there's one thing we must always do in order to make the wisest decisions possible--get the facts. □

IF · YOU · CAN · DREAM · IT · YOU · CAN · DO · IT



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